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FRAME AND BRICK HOUSES BARNS STABLES AND OUTBUILDINGS

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FROM

ESTIMATING

FRAME AND BRICK HOUSES

BARNS, STABLES, FACTORIES AND OUTBUILDINGS

Eighth Edition, Enlarged, Amended and Modernized

BY

FRED. T. HODGSON

Containing a detailed estimate of a $5,000 house and additions. Detailed estimates of kitchen, dining-room, parlor, den, halls, bedrooms, conservatory, basement, bath-room, closets, etc., all figured out and measured by the quickest and simplest methods. Also showing how to estimate by cubing, by the square of floors or walls, and by the process of comparison; with hints and practical suggestions for taking measurements and making tenders for work.

❧

Published by
DAVID WILLIAMS COMPANY
14-16 Park Place, New York
1910

Eng 609.10

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May 22, 1925
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PREFACE TO EIGHTH EDITION.

The fact that this little book has gone through seven editions, under the title of "Estimating Frame and Brick Houses," is convincing evidence of its usefulness and worth. The steady demands for it, after being in the market for more than ten years, has induced the publishers to have a new revision of the work on an enlarged and improved basis. They have decided to go to the expense of almost rebuilding the work, and giving it another title, in order to bring it in touch with present methods and current prices of builders' work. The author has endeavored, in the present edition, to make the work as generally useful as possible, and so construct it that the builder living in any State of the Union, may make use of it as a basis for making his estimates. Though the rules given may not conform with the local rules of any particular locality, yet they will be found to meet the requirements in general of forming a basis for estimating the nearest possible cost of the different items in builders' work. In the preparation of estimates of the various departments of builders' work, there are certain elements which must always be borne in mind in connection therewith. First, as regards the material, its accessibility to the building site, and expense of carriage thereto. Then, there is the labor entailed in its preparation previous to being fitted up or built, and the necessary time and material required for doing so in accordance with the specifications.

Some kinds of material are more easily wrought than others, so that due allowance must be made for any extra labor that may be employed in the manipulation of very hard classes of material. Again, there is the preparation of the material for the proper execution of any contingent workmanship and the expense of workmen employed. The season of the year in which the work has to be done, and the current prices of material and workmanship, must have also careful consideration, otherwise these contingencies may cause a serious loss if neglected to be taken into account. All these elements must enter into the consideration of the price of every item when computing the cost. There should be no "guess work" in estimating, as is often the case. Of course, a uniform system of measurement for the various classes of work in building operations would obviate this unsatisfactory condition of estimating. But seeing that it is impracticable at the present time, it is the duty of every contractor who is framing an estimate to give these points previously indicated careful attention. By doing so he is not only protecting himself from loss, but also the manufacturers who supply the material for the work. The contractor who frames a thoroughly reliable contract comes out right, whether he be successful in getting the job or not, for if he gets it, then it adds to his reputation; if he does not get it, then he feels satisfied that he is no loser by accepting a job that would not pay him, and he is exempt from the bad reputation of those who "scamp" the work in order to make ends meet. The rules for "Order in Estimating" which follow, will be found of service in the framing of estimates, and if proper and accurate attention be given to all these details, there should be produced a tender that will be satisfactory to owner and contractor alike.

THE AUTHOR.

Order in Estimating.

It will be well if the estimator will follow the order we have laid down in these remarks when making out his estimate—that is to say, he should first begin with making out the cost of surveying and laying out the grounds for the foundation. Then follows the excavating, bearing in mind the distance the earth has to be conveyed, also the kind of earth to be excavated, and the cost of drainage, if such is required to be done. Next follows the stone work, and careful measurements should be made from the plans, taking in and making such provisions for waste and extras as we have pointed out among the earlier pages. Be sure of the cost of this work per cord or perch in the wall before closing a tender

This will be followed by the brick work, and we would suggest that the figures for these various works be kept in separate books, and marked so that they may be referred to again if necessary.

In estimating the brick work be sure not to miss chimney projections, piers of verandas, porches and stoops. If the building is to be faced with pressed bricks backed with common stock, find out the difference in size between the two kinds of bricks, and, if any difference does exist, see how it is going to affect the work, and provide for it accordingly. Sometimes this difference is the cause of considerable trouble and expense. Figure up on the mortar required, and if colored mortar is going to be employed don't "jump" at the cost, but find out exactly. The quantity may be obtained for each 1000 of bricks in the early pages or from any builders' text book.

Timbers, joists, studding, rafters and other coarse lumber should be figured out exactly and classified according to price, so that the cost can be ascertained. Then follows the roof covering, shingles, slates or metal; floors, bridging, trimmers, strapping or furring, lathing and plastering. Measure plans closely in every case and be sure you are right. Next estimate for labor in placing floor timbers, partitions, roof timbers and all other rough carpenter work. Then follow with estimate of all finished wood work, frames, sash, doors, wainscot, mantels, stairs, trimmings and fitments throughout. Stucco work and other ornamental plastering should come next, then all the painting, glazing, finishing and varnishing and every item that belongs to the painters' trade.

Estimating Plumbing.

If, as is sometimes the case, the general contractor has to estimate on the plumbers' work, he should either consult a plumber or make himself conversant with the prices of labor and material current in this trade, and should be careful in obtaining lengths of piping, number of couplings, number of cocks, traps and other appurtenances, and should make ample allowance for breakages, misfits, extra digging and cutting and other similar shortcomings. If not master of all details in connection with plumbing, he should by all means employ a regular plumber to make out his estimate for this branch. The same may be said for the heating, for if a young contractor undertakes to do this work for himself and employ regular tradesmen to perform it, he will very likely regret it. The same may be said of electric lighting or putting in electric bells. Our advice in this matter is that experts in these trades be asked to submit figures for which they will agree to perform the work and furnish all necessary materials in conformity with the true intent of the plans and specifications.

After obtaining by careful estimation the cost of a building, a percentage for profit must be added. This percentage may be more or less, according to prevailing conditions, but under no consideration should it be less than 5 per cent. or more than 25 per cent. on the entire cost of the building. If the figuring has been accurate, and the estimator is possessed of ordinary judgment, 10 per cent. will prove ample to give a fair and reasonable profit on the work.

The Frame House.

The Frame Construction.

Excavating.

In order to be able to make a correct estimate of the cost of any building, a plan of the structure is an absolute necessity. If no plan is furnished by the architect, then prepare with pencil or ink a ground plan, also a plan of the second and other stories, showing all parts, stairs, chimneys, doors, windows or other openings. Mark in plain figures on these plans the dimensions and the measurements of everything in the building of which an estimate is desired. Let us suppose a building of any reasonable size, of balloon frame, and to stand on a stone foundation, to be the one on which an estimate is to be made. If we are expected to do the entire work we should, if possible, see the site, so as to get an idea of the amount of excavating that may be required. We shall also want to know the kind of earth to be removed, and the distance it will have to be conveyed. It requires a full day of nine hours to dig and fill into a car or wheelbarrow 12 cubic yards of common coarse gravel or clay. A sound man will wheel and unload the former material 100 yards away in one day and the latter in seven hours. Given the wages paid per day and the number of yards to be excavated, and it is a simple matter to ascertain the cost.

Cost of Stone Work.

The excavating being finished, we next want to know the cost of the stone work. In many parts of the country

Note.—Based on nine-hours days work.

stone work is measured by the perch, which is 16½ feet long, 1½ feet thick and 1 foot high, containing 24¼ cubic feet. In estimating, however, 25 cubic feet are regarded as a perch, and in the solid wall will contain about 22 cubic feet of stone and 3 cubic feet of mortar. In some localities stone is measured by the cord of 128 cubic feet. This, in the opinion of many well qualified to discuss the subject, is the better method of measurement. One hundred cubic feet measured in the wall is considered 1 cord, and the estimator must make a note of that. Corners or quoins are measured without reduction for thickness; then a tape line run all around the wall on the outside and meeting at any point is the total length of the stone work. To lay 1 cord of ordinary quarried stone will require 2½ bushels of lime and 5 barrels of sand.

A day's work for a mason's helper on work of this kind is to move 1 cord of stone to the mason and to mix and carry the mortar for laying the same. A mason will lay 1 cord of stone in a day of nine hours, therefore it is easy to estimate the cost of putting in a stone foundation after the number of cubic feet in a wall are known, for we have:

1. **Cost of 128 feet of stone, delivered.................. $......**
2. **2½ bushels of lime and 5 barrels of sand............ ......**
3. **Mason's wages, one day......................... ......**
4. **Laborer's wages, one day........................ ......**

Total .... $......

As prices differ in various localities, the estimator can fill in the blanks to suit the prices prevailing in his place.

Brick Work.

There is always more or less brick work to be done in connection with a wooden building, such as fire places, chimneys, piers, etc., and we will next turn attention to it. Brick work is estimated by the 1000 brick, but as the building under consideration does not contain much of this work we will content ourselves with giving a few rules for estimating for fire places and chimneys only, leaving the greater questions to be dealt with at another time. In building common brick fire places and ordinary flues, a workman will lay about 600 brick a day, and it will require a laborer to wait on him and prepare the mortar. To lay these brick will require 1¼ bushels of lime and 7 bushels of sand. One cubic foot of brick work takes 22 brick, so the solid contents of a chimney or fire place should first be obtained in cubic feet; then when multiplied by 22, the number of brick required to do the work is ascertained. The cost thus obtained holds good if the building is two stories or less. If more than two stories in hight 10 per cent. of the cost for each story above the two must be charged. Extra charge should also be made when the interior of the flue is plastered or "pargeted." This charge will, of course, depend upon the size and length of the flue. As a rule, chimneys in small houses where no fire places are employed cost about 40 cents per running foot for single flues, and 75 cents per foot for double flues, these prices, however, being only approximate.

Timber Work.

Next in order is the timber work, and the first thing to be done is to obtain the linear measurement of all the sills and from their size estimate the number of feet, board measure. A ready reckoner, one of the many in the market, should be at the estimator's elbow, in order to save time in making the estimates. Retain the linear measurements, as from these the amount of labor is determined. The labor on sills is of three kinds:

1. Framing without gains for joist or mortises or for studding, as in common building, where the studding is spiked to the sills and the joist rest on top of the sills.

2. With mortises for studding, gains for joist, or studding without mortises.

3. With both gains and mortises, for studding.

Sills 6 x 8 inches framed and placed on the wall by the first, second and third processes will cost for labor 2, 4 and 6 cents per linear foot. Sills 12 x 16 inches require double the above prices. The intermediate sizes may be approximated.

Joist are generally placed 16 inches from center to center, and when so placed the number required on a given floor may be found by taking three-quarters of the length of the building and adding one joist when they are placed on top of the sill, and deducting one when the sills are utilized to receive the flooring. The first-floor joist may be 2 x 8 to 2 x 14 inches; the second-floor joist are usually from 2 x 8 to 2 x 12 inches, and the top ceiling joist are usually from 2 x 6 to 2 x 8 inches.

A man will frame and put in place in the building about 700 feet, linear, of joist, having dimensions from 2 x 6 inches to 2 x 14 inches, provided he has not more than two stories to lift his stuff. In putting on plates, which in balloon frames should be doubled, with joints well broken, the cost will be 1 cent per linear foot for each thickness. Studding is usually placed 16 inches from center to center, and may be 2 x 4 or 2 x 6 inches. If the former, two men will lay out and raise 800 linear feet per day, and if the latter size, 750 feet. A short rule for obtaining the number of pieces of outside studding, including plates and allowing one piece of studding extra for corners, windows and doors, is to allow one stud for every foot in length of wall. This rule for buildings having many angles, where the studding must be doubled, approximates very closely to the true result. In smaller buildings with but few angles it will somewhat overrun.

The exact number of pieces of outside studding may be obtained by taking three-quarters of the number of feet in the outside measurement of the building and adding one stud for each angle and one for each door and window. To this add for the plates and gable studding. For partitions take three-quarters of the number of feet the whole partitions measure in length, and that figure will be the number of pieces of stuff required. The length of the studs will, of course, depend on the hight of the rooms. This number provides for double studs at the doors. The cost of labor in putting up the partitions is the same as for putting up outside walls.

When "cut-in" ribs are used for supporting the upper joist about 1 cent per linear foot is to be charged, which will cover the cost of "notching" the studs, making the ribs and spiking them in place. In estimating material for studding the gable, take three-quarters of the length of the base and the number of feet, less one, which will give the number of pieces required. The average length of each piece is the distance from the plate to the ridge of the roof, or what is termed the rise of the rafter.

The Rafters.

Rafters are designated as main or principal rafters, hip rafters, jack and valley rafters and plain rafters. The long rafters in a pyramidal root are called hip rafters, the shorter ones cutting against the hips are called the jack rafters. A plain rafter is the ordinary rafter used in common gable or saddle roofs. The projection of a rafter is the distance it extends beyond the plate or hangs over the wall. The rise of a rafter is the hight on a perpendicular line from the plate to the ridge of the roof. The gain of a rafter is the difference between the run and its length, the run being the distance from the outer edge of a plate to a point immediately under the ridge of the roof, or one-half the width of the building. The lengths and bevels of rafters of any pitch may be obtained at once by the use of the steel square, when properly understood and applied, and every good carpenter ought to understand and apply this useful tool in every case of roof work.

Main rafters intended to receive a shingle roof are placed from 16 to 24 inches from center to center, according to their length and the weight of the roof they are called upon to carry, 2 feet being the usual distance. The number of rafters in a plain gable or saddle roof is found by dividing the length of the building by the distance the rafters are apart from center to center, to which add 1, the result being the number of pairs of rafters.

Roof Work.

Two men will frame and put in place 600 linear feet of 2 x 6 inch or 2 x 8 inch rafters in one day on a plain gabled roof; in a hip roof, including framing for deck, when there is one, 250 feet, running measure, is a good day's work for one man. It must be understood that these estimates are based on the supposition that nine hours constitutes a day's work, and that the material used is soft wood, such as pine, hemlock or spruce. Any deviation from the plain work as set out in the foregoing, such as circular, segmental or octagonal work, requires an additional allowance for time and material, varying from double for octagonal to quadruple for circular. Of course something will depend on the character and position of the work. In preparing the lookouts for hip roofs and setting them, including the nails and all material, 17 cents each is about a fair price, basing the wages of the workman at $3.50 a day. This means leaving the lookouts and eaves ready to receive finish for the cornice.

In closing in the building with rough stuff, as is the custom in the Northern States, it is better to run the stuff through the planer and reduce it to an equal thickness before using. The cost will not be much, and the stuff will be more easily handled and will make a better job when finished. In the case of dwelling houses a man will cut, fit and nail on 1000 feet of rough lining in a day, but on a barn or outhouse, where there is not so much fitting, he will be able to do much more.

Siding or Finishing Stuff.

The siding or finishing stuff for a building may be either drop siding, lap siding or simply matched sheathing. The number of feet of drop or lap siding is found by multiplying the outside measurement of the building by the hight of the studding, to which add for gables. In the case of a gable roof multiply the width of the building by half the hight from the plate to the ridge of the roof. This gives the number of surface feet, to which add one-fifth for lapping, and the result is the number of feet surface measurement. In putting on siding it is always better that two men work together, as they assist each other and the plan is more advantageous. Two men will put on 500 feet of siding a day, or 250 feet each, and cut close against window and door casings and corner boards When a building is boarded vertically, or up and down, and the stuff is dressed and matched, two men will put up and nail about 2000 feet, board measure, and build their own scaffolding. This method of sheathing will require to be battened, and it is worth 25 cents per 100 feet, running measure, to cut, fit and nail on the battens. If building paper is placed under the siding or sheathing it is worth 25 cents per roll to nail it on the walls.

The area of a plain gable roof is found by multiplying the length of the rafter by the length of the building, including the projection of the cornice. This gives one side of the roof, and by doubling we obtain the area of the whole roof. One thousand shingles if laid 5 inches to the weather will cover one square of 100 square feet. A man will nail 1500 shingles per day and carry them up to the roof. If a layer of coarse mortar is placed under the shingles 70 cents a square extra should be charged for labor and material. It will require 6½ pounds of nails to lay the shingles. If building paper is used on the roof and the shingling is done over it, 30 cents a roll must be added for laying the paper and extra work in connection therewith. This relates only to ordinary gable or saddle roofs. Hip and valley roofs, as well as circular and tower roofs, are more expensive to build.

Hip Roofs.

In order to obtain the area of a hip roof, take the entire outside measurement of the building, including the projections of the cornice. This is multiplied by the length of the principal rafter, and one-half of the result is the area of the roof. In making an estimate for a hip roof, it must not be forgotten that at least 30 per cent. extra must be added for extra labor over an ordinary saddle roof in preparing and setting the rafters. For covering the roof with rough boards—labor only—the average cost is 50 cents per square, based on wages at $3.50 per day. If the roof boards are matched for tin or slate allow $1 per square for labor. If there is a deck on the roof add 2 per cent. to the gross estimate, this being about the cost for extra cutting and fitting around eaves of deck. There will also be a waste of material in a hip roof that will amount to at least 5 per cent. on the total amount of stuff employed, and a further waste of 1 per cent. if the roof terminates in a deck.

The standard width of a shingle is 4 inches, and a quarter bunch of shingles is supposed to contain 250, each 4 inches wide, which when laid cover a line 1000 inches long, or they would lay one course 83 feet 4 inches long. When shingles are laid 4 inches to the weather each shingle will cover an area of 16 inches, so that 900 so laid would cover an area 10 feet square. Shingles, however, rarely hold out what they are supposed to cover, so that it is better to estimate 1000 shingles for each square of roofing than to confine ourselves to the actual measurement. In hip roofs 5 per cent. should be added, owing to the great waste in cutting about the hips; the same rule should obtain with a roof having four or more valleys in it.

Cost of Tin Roof.

In estimating the cost of a tin roof, the timbers, boarding, paper—if any is used—and ribs must be considered. Generally a tin roof is a " flat roof," and the timbers employed in supporting it are, as a rule, heavier than are the timbers in an ordinary saddle or hip roof. The boarding, which is generally matched, will cost as much to lay as will the boarding of a saddle roof, so those figures may be taken as a guide. Then add paper or felt, or whatever may be laid under the tin, and charge about 25 cents per roll for laying. The cost of ribs, besides cost of laying same, will figure up to 10 cents a square.

A sheet of roofing tin is 14 x 20 inches, and a box of tin contains 112 sheets. Allowing a fair percentage for covering the ribs, and for top and bottom laps, a box of tin will cover 182 square feet, and, approximately, is worth $7 a box for IC charcoal tin, so the total cost of laying it on roof and leaving it finished will be about as follows:

1 box of IC charcoal tin	$7.00
2 pounds of tinned nails	.50
10 pounds of solder at 20 cents	2.00
Preparing tin for roof	2.00
1¼ days laying tin at $3.50 per day	3.75
Total	$15.25

This would make the actual cost of laying one square of tin a trifle less than $8. It must be understood that the prices given for materials are not to be considered as "fixed." The estimator must ascertain for himself the actual prices current in the locality in which he resides and change the figuring to suit.

In preparing tin valleys for shingle roofs, the tin should in no case be less than 14 inches wide, and where the pitch is low a wider tin should be used. For a slate roof 20 inches is the narrowest that should be employed. The average price for tin valleys with tin put in place is from 9 to 10 cents per square foot. On an ordinary roof that is not very steep a man will lay about 150 square feet, but if the roof is steep, with the valleys short and much cutting and fitting required, one square properly laid may be considered a good day's work. For tin flashings about chimneys, or where the work requires such in the junction of buildings, or where a roof adjoins a brick wall, 11 cents per foot will be a fair price for the work finished. If step flashing is required, which means that the mortar is to be cut out of the joints of the brick work, the flashings inserted and the joints filled up with Portland cement, the work is worth from 12 to 14 cents per foot completed, according to the character of the roof. In all cases the tin should be measured before being cut, as the "laps" in flashings are uncertain factors, and vary in almost every case.

The work of the tinsmith, in all cases, should be well thought out before prices are decided upon. In making prices for gutters it should be borne in mind that the ordinary tin gutter that generally forms the crown molding of a cornice does not cost as much as a gutter that is inclosed in wood on the three sides.

A 4-inch gutter, open, costs per foot, lineal	$0.12
A 4-inch gutter, closed, costs per foot, lineal	.14
A 5-inch gutter, open, costs per foot, lineal	.14
A 5-inch gutter, open, costs, per foot, lineal	.16
A 6-inch gutter, open, costs per foot, lineal	.16
A 6-inch gutter, closed, costs per foot, lineal	.20

The extra wood work and labor to be performed by the carpenter in preparing for a closed gutter will cost about 6 cents per foot running measure for a 4-inch gutter; 7 cents for a 5-inch, and 9 cents for a 6-inch gutter. If gutters are formed of galvanized iron instead of tin an additional 1 or 2 cents per foot should be added for extra work and extra cost of materials. Down spouts, made of tin, when in place, may be estimated in accordance with the following prices:

For 2-inch spouts or conductors, per running foot	$0.10
For 3-inch spouts or conductors, per running foot	.12
For 4-inch spouts or conductors, per running foot	.14
For 6-inch spouts or conductors, per running foot	.30

If made of galvanized iron they will cost from 1 to 5 cents per foot additional, and if square, spiral or corrugated will cost still more. These prices will, of course, vary a little in different localities, owing to a difference in the price of labor and materials, and the estimator will do well to consult the various tradesmen in his own locality as to prices before closing up his estimate. If, however, he has no opportunity of doing this, he may accept the foregoing figures as being fairly representative.

Slate Roofing.

A "square" of slating is 100 superficial feet, the same as a square of flooring, but in estimating slating much more stress must be placed on the fact that the cost of cutting and fitting around chimneys, ridges, valleys, hips, dormers and saddles is greater than obtains in the cutting of shingles. The price of slating per square for plain work ranges from $7 to $14, according to the kind of roof slated. If there are no valleys, dormers, etc., the lower price will cover the cost, but if there are breaks of any sort in the roof the price should be advanced to suit the situation. If a roof is to be covered with multicolored slates and laid out in patterns the cost per square will be materially increased, and as the intricacy of the pattern will regulate the price, it is next to impossible to make a correct estimate of the cost without knowledge of the pattern to be estimated upon. We are safe in saying, however, that $1 per square more should be charged for plain patterns, and from $2 to $4 more per square for elaborate patterns, where much cutting has to be done. The estimator, however, should provide for himself a copy of some work in which slate laying tables are given, along with styles and patterns, and the probable cost per square of each style when laid on the roof. Probably the best published in this country are "Stafford's Slate Tables," and "The Slate Roofer," the latter by D. Auld. These works, if consulted by the estimator, will greatly aid him in arriving at a correct figure to place in his estimate for a slate roof.

Cost of Cornice.

To find the exact cost for finishing a cornice on a frame building a thorough knowledge of all the conditions is necessary. It costs about 5 per cent. more to build a cornice on a three-story building than on a two-story building, both cornices being the same in style and dimensions, and for a four-story building the extra cost will be fully 12½ per cent., and the same proportion of increase will obtain as the number of stories increase. The figures given herewith are prepared for a two-story building only. A plain cornice consists of three members—namely, fascia, planceer, and frieze. A more pretentious cornice is furnished with a bed molding and a crown molding. A still more pretentious cornice is provided with all of the foregoing, and has also brackets at regular intervals with a paneled frieze and fillet molding on the bottom of the frieze. The cost of putting up the first style of cornice, including building scaffold and making ready, will be 10 cents per foot, running measure, the whole length of cornice from fascia to fascia all round the building to be measured. For the second style of cornice with bed and crown molding charge 12½ cents per foot, measuring by the same rule as that just given. The third style of cornice will differ so much that a fair estimate will be difficult to obtain unless we know the exact character of the work, therefore the best we can do is to estimate it in detail. A plain fascia with ogee 6-inch molding is worth 6 cents per foot. Planceer with one member—bed molding—8 cents per foot, and 1 cent per foot more for every extra member in bed molding; paneled frieze ready to put in place, 3 cents per foot. If the frieze is to be molded so as to show the panels after being put in place, 5 cents per foot should be charged. When brackets are to form part of the cornice an additional 1 or 2 cents per foot should be put on the cost, as the "cutting in " of molding between brackets requires more time and labor.

Putting Up Brackets.

In putting up brackets much of the cost will depend on the size, style and number. If sawn from one piece of plank, nailed in place, and the bed mold only " cut in " between them, they are worth 3 cents each to put in place. If built up of three pieces of stuff, with bed mold just cut in between, 4 cents each for placing will not be out of the way. If the top member of the bed mold is carried and broken around the top of the bracket, 12 cents will be about a fair price for each bracket. If, as is sometimes the case, the top member of the bed mold is broken or mitered around the top of the bracket and the lower member of the bed mold is carried around the sides of the bracket next to the frieze, 25 cents should be charged. These prices include work on the gable cornices as well as horizontal cornices. If there is a preponderance of gables an additional percentage of from 2 to 4 cents per foot should be added.

In these estimates it is supposed that all the work has been prepared in the shop before being taken to the building, and that no dressing or finishing is necessary to be done on it before being put in place. The cost of the material and of the labor necessary to prepare it must be added to the prices given in order to get the exact cost of the work.

Material for Cornice.

In estimating the amount of material in a given cornice for a square roof, multiply the entire outside measurement of the building by the sum of the width of the frieze, planceer and fascia, and the sum obtained will be the number of feet, board measure. Add 10 per cent. to this amount for waste in dressing, mitering and joining. For gables take the whole length of end rafters, add end projections, and multiply same as before. All the above estimates are based on a cornice that will not exceed in dimensions the following figures: Frieze, from 9 to 16 inches in width. Planceer, from 9 to 22 inches in width. Fascia, from 4 to 7 inches in width. Anything over and above these measurements should be charged for in proportion. Sometimes a planceer is formed of narrow stuff, matched and beaded, and when this is the case 30 per cent. should be added to the cost of labor in putting up the work. Moldings for outside cornice work are generally charged at the rate of 1 cent per foot per inch in width, less, ½ cent per foot. Thus, a molding 2 inches wide—pine, basswood or poplar—by this rule sells at 1½ cents per foot, and one 3 inches wide at 2½ cents per foot, etc. The price of brackets such as are ordinarily used on the kind of building under discussion is about as follows, when made of pine or other soft wood and finished ready to place in position:

	Perpendicular. Inches.	Horizontal. Inches.	Thickness. Inches.	Cost. Plain.	Cost. Molded.
Size.........	16	12	2	$0.30	$0.40
Size.........	20	16	3	.55	.65
Size.........	24	20	4	.75	.90
Size.........	28	24	5	1.00	1.10
Size.........	30	28	6	1.40	1.70

In running a cornice around an octagon tower, a semi-octagon bay window or veranda, 25 per cent. should be added for labor. Circular and elliptical work should be charged one and a half times more than straight work. This rule holds good also in the preparation of the stuff for all segmental, circular and elliptical work. With more elaborate cornices than those enumerated in the foregoing we are not at this time concerned, for such buildings as are now under consideration rarely if ever require cornices richer than are here presented.

Interior and Exterior Trim.

Laying Floors.

In laying floors much depends on the width and quality of the stock. If good material is used and the stuff is 4 inches or less in width it is worth to lay it 60 cents per square. If more than 4 inches in width, 56 cents per square is a fair price. This, of course, is for laying only with square butt joints. If the butt joints are grooved, and "feathers" or slips run in them, 85 cents per square should be charged for the wide and 95 cents for the narrow flooring per square. Hard wood flooring takes about one-third more time to lay down than pine or other soft woods, and where the blind nailing is done on every joint, as it should be in the case of hard wood flooring, from 3 to 5 per cent extra should be added to the cost of laying. Where much cutting and fitting have to be done, as is sometimes the case in halls and rooms of odd shape, an additional 5 per cent. should be added to the cost of labor. In estimating the amount of material required for a floor, get the number of feet board measure, in the floor, then add one-fifth for matching and waste; also measure in all openings as though they were not there, including well holes, hearth spaces, chimney openings and traps. If the rooms are irregular or circular ended charge the same as if the room carried its whole width to the extreme end. The prices given herewith are for first floors. When flooring has to be handled or hauled up any number of stories

5 cents extra should be charged per square for every story it has to rise; thus, in a five-floored building, 20 cents per square extra should be added for extra handling.

Rough floors of 1-inch boards, irregular widths, are worth to lay and nail down, 20 cents per square. If dressed and the joints laid close charge 28 cents per square. If the edges are jointed and the boards narrow, charge 30 cents per square. If the floor is double—rough floor underneath, matched flooring on top and paper between—charge 2 cents per square for laying the paper. If paper is laid down on rough floor and ⅜-inch strips of wood placed over the paper on top of the joists, charge 4 cents extra per square for putting down and nailing the strips. The cost of the material forming these strips must be added to the foregoing, so also must the cost of all the nails required to complete the work.

In laying down veranda and porch floors, where the joints—side and butt—are painted, 20 cents per square should be charged for this service, besides the cost of the paint. All "butt joints" in veranda or stoop floors should be painted. The same rules of estimating apply to "decks" on roofs, balconies, or other similar positions as obtain in connection with veranda floors, only, of course, allowance must be made for the extra handling of materials.

Wainscoting.

Wainscoting, matched and beaded or otherwise molded, with rebated cap and cove, is worth $1.25 per square to put in place and properly finish. If a quarter round is placed in the angle at the junction of floor and wainscot, add 3 cents per square more. If the wainscoting is paneled, and built at the factory ready to set up, the cost for labor of fitting in place and properly finishing will be about $2.00 per square, and if there are many angles or circular corners to turn $2.50 per square should be charged over and above the cost of making the panel work. Paneled wainscot, molded and finished, ready to put in place, made of mahogany, oak, birch, cherry or other hard woods, will be worth, before being delivered in the building, all the way from $8 to $50 per square, so the estimator should first get the cost of the paneled work at the factory or wherever it is to be made before he makes up his final figures. As the difference in cost is altogether dependent on the style of work and character of material, no estimate of the cost per foot or square can be given unless drawings and description are furnished. If plain beaded or molded hard wood wainscot is used, it will take about one-third more time to put it in place than soft wood, and, of course, the material will cost more.

Plain pine base, from 6 to 10 inches wide, put up before plastering, is worth to fix in place 2 cents per lineal foot. If the base has to be smoothed and prepared it will be worth 3 cents per foot. If the base is formed of two members, the lower one grooved and the upper one tongued and molded, it is worth 3 cents, running measure, to fix, 30 cents for each internal angle when coping has to be done, and 10 cents for each and every mitered external angle.

If the base is composed of three members, and has an elaborate molding to cope, it will be worth to fix it 4 cents a lineal foot, 40 cents for fitting and coping each internal angle and 20 cents for mitering each external angle.

For cutting, fitting and fastening in place a quarter round carpet strip against base or wainscot, charge 70 cents per 100 feet. For trimming base around mantel, where the moldings return in themselves, charge from 50 cents per mantel up, according to finish. Allow for waste in all baseboards about 5 per cent. It is worth about ¼ cent more per lineal foot to put on base after plastering is done than before when "grounds" have been previously planted and ⅜ cent more if there are no "grounds" to which to nail.

Doors and Frames.

To make an ordinary outside door frame, setting it in place and trimming with band molding inside, hard wood sill, the whole complete, is worth $2.00. To hang the door, trim with mortise lock and three hinges, bolt, etc., complete, will cost $1.20 more, making a total for finishing the door, with all stuff furnished, of $3.25. The price of the door may readily be ascertained at the local door factory. If a fanlight is to be added charge 70 cents extra for transom and for fitting sash. If the head of frame is segmental add 50 cents more, and if semicircular charge double price for frame and trimming. If there are sidelights and transom with square head, the labor on frame complete, when in place, including hanging door, fitting sash, cutting in mullions and trimming door, will cost $7.50; with segmental head the total cost will be $9.

It will require for the making of a frame similar to the last one, for a frame building boarded inside and out, about 70 feet, board measure, of pine or other suitable material, and one piece of oak or other suitable hard wood, 7 feet 6 inches long, 10 inches wide and 3 inches thick for sill.

Knowing the price of this material, to which add the price of two pounds of nails, the total cost of frame, minus door and sash, may be found.

Inside door frames are worth to make, set in place and case, $1.60, and with band moldings on both sides 50 cents more, making the total cost of labor for each door frame, ready for the door, $2.10. The price of doors may be taken from any dealer's catalogue.

A man will fit, hang and trim five doors each day, and an estimate based on this performance will be found to come out about right. The author has seen a man hang, fit and trim ten doors—1¼ inches thick—in one day of 10 hours, but this was an extraordinary feat, and the hanging and trimming were not such as could be recommended. Five 1⅜ or 1¾ doors are as many as the average workman will be able to hang and trim in a satisfactory manner.

Frames for a pair of sliding doors are worth to make, fix and case $4 per pair, with 50 cents more if band moldings are used on both sides. The same with segmental head will be worth from $5 to $8. To line the pocket with matched stuff and adjust overhead rails ready to receive hangers is worth $4. It will take one man about 1½ days to properly fit, trim and adjust a pair of sliding doors. If door frames, casings, doors and fan and sidelights are hard wood, 50 per cent. must be added to the foregoing prices, and when the locks are mortise locks from 25 to 35 cents should be added to the cost of each door for mortising and for adjusting the locks. If fanlights are used over inside doors, add 40 cents extra for labor on transom and fitting sash. If transom lights are hung add 20 cents more. Batten doors hung, fitted and trimmed with thumb latch, cost 60 cents each for the labor and are worth about 90 cents each, making the door when in place cost $1.50, exclusive of cost of frame and hardware. Cellar and other doors having T or strap hinges and hook and staple fastenings will cost 65 cents each for the labor of hanging and trimming.

Windows and Their Frames.

Perhaps no portion of a house will vary so much in the cost of labor as will windows and window frames, owing to there being so many styles, sizes and characters of frames. The frame, however, best suited for such a house as we have endeavored to keep in sight while preparing these remarks will be simply a box frame made to receive double hung sash and outside Venetian blinds.

Cost of making the frame	$1.75
Casing and setting frame	.70
Fitting in stool	.15
Fitting and hanging sash	.65
Putting in stops and molding casings	.30
Hanging and trimming blinds	.40
Putting on sash lock and lifts	.15
Total for labor	$4.10

In practice it is much better to allow $4.25 for a frame of this kind if the house is two stories or more in hight, as the foregoing estimate is based on the supposition that the frame is on the first floor and that everything is favorable to the work. If the frame and material have to be carried upstairs more time is required, and time is money; it also costs considerable more to hang blinds on a second story than on a first. Experience has proven over and over again that it costs more to finish a piece of work of any kind about a house than it does to finish a similar piece of workthat has been specially designed to be finished as an example. Neither man nor conditions are the same at all times, and the tendency is to greater cost all the while; therefore it is always dangerous to accept a contract on a close estimate. A fair but not excessive margin should in all cases be allowed for unfavorable conditions.

If a window frame has a segmental or semicircular head the cost will materially advance, and if the finish is to be of hard wood, with hard wood sash, the cost will be nearly double. For twin, triple and transom sash ample allowance must be made on the basis of the foregoing figures. Dormers, skylights, eyebrow frames and cupola lights generally cost more than ordinary windows, if finished in the same style.

Cellar window frames with subsills to rest on stone sills will average about $1 each for labor, which will include fitting sash, hanging and putting in stops.

The price of sash, ready glazed, may be obtained at the factory if desired, or the sash may be bought separately and the painter made to furnish glass and do all glazing.

In making an estimate for a semi-octagonal bay window, built in the same style as the window mentioned, including boxing for weights and complete finish for inside, we find the labor will cost $35, while the material, based on New York prices, will cost $60, making the total cost of bay window complete $100. This figure will be found ample for almost all parts of the United States and Canada. If the window is finished in hard wood and filled with plate glass, the cost will be about 90 per cent. more.

Pantries and Closets.

In fitting up pantries and closets much depends on what has to be done. Some of these places are fitted up very elaborately while others are quite plain and cheap. As a help at arriving at the cost I might say that one man will put up and finish from 60 to 75 feet of shelving 12 inches wide in a day, which will include nailing up battens and cleats to receive shelving. He will also make carcase and four drawers and put up same in closet in one day, if the drawers are not dovetailed. If drawers are dovetailed and finished with locks and pulls it will require two full days to build carcase and four drawers and put them in place. About 80 feet in length of 3½ inch or 4 inch battens, furnished with wardrobe hooks, will be all a man can properly do in one day.

Hard Wood Finish.

Hard finish, so called, is generally charged by the yard, and requires superior workmanship to accomplish satisfactory results. The cost of performing this work depends very much on the character of the wood work, both as to its workmanship and its style. If elaborate and the workmanship good, the finisher may ask from 90 cents to $2.00 per yard. If the workmanship is of poor quality, and the finisher has to smooth it and double fill it, he may ask even more than the latter figure. Where the wood work is plain it may be done for less. We have seen very good work done for 75 cents a yard in exceptional cases. Where work of this kind is called for by the specifications the estimator had better get prices from local artisans, the prices to include all materials required.

Plumbing.

Kitchen sinks are worth about $1.50 to inclose, without including cost of material, shelving and hook strips cost about the same as for closets and pantry.

With regard to bathroom, if a plain bath and water closet are used, the carpenter making all wood work, to inclose same and finish, ready for painter, including tank and other fittings, it will take about three and a half days' work. This, of course, is independent of the plumber. If an inclosed wash basin is added to bathroom this will require another day to make and set up. If the house contains, say, ten rooms, and it is furnished with hot air, steam or hot water service and water, about 20 per cent. should be added to plumbers' estimate for cutting and fitting and extra material and profit. This 20 per cent. shall be added independent of the cost of air ducts, washstands, water closet, bathtub, finishing or any of the visible work. Experience has proved that this percentage is not a bit too much.

The estimator will do well to obtain plumbers' prices before giving in his tender, and he should bind down the plumber to follow the specifications to the letter. This precaution may prevent trouble in the future.

Stair Work.

Usually a flight of stairs may be obtained at a factory very much cheaper than if made in the building; but as there are many cases where the stairs must be built in the house under construction, it will be necessary for the estimator to have a knowledge of the cost. Stair builders generally furnish their prices at so much per step or tread, including rails, balusters, newels and other requirements, all complete and fixed in accordance with plans and specifications furnished to them by the architect. The cost per step depends very much on the style and finish of the work.

An ordinary plain staircase, built of pine, 3 feet wide, with returned nosings and scroll brackets, hard wood rail—birch, cherry or oak—turned newel and balusters, fixed and complete, including all material, is worth per step $4.37. Suppose a flight of stairs consists of 17 steps, the total cost would amount to $64.60, which may be divided about as follows:

Material for body and carriage of stairs	**$18.40**
Labor of making and fixing same	**14.95**
Hard wood rail, balusters and newels	**29.90**
Setting and fixing rail	**11.04**
Total	**$74.29**

This, of course, includes rail and balusters around well hole and cylinder, and is estimated for a first-class piece of work. A stair with a square cut string, 1¼ treads, no brackets, square return, plain 3-inch rail and

1¼-inch balusters, may be built for $2.76 per step, which would be divided about as follows:

Material for body of stairs, etc.	$10.15
Carpenter work on same	6.97
Rail, newel and balusters	23.00
Setting up and fixing rail, etc	6.80
Total cost	$46.92

The author does not advise the building of this kind of stairs, particularly if the stairway is situated in the entrance hall. It is not the fashion now to build straight flights of stairs where such can be avoided, for with the introduction of the Colonial and Queen Anne style of buildings the rule for stairways is short flights with rests or landings. This rule is, perhaps, the only good thing come to stay that these styles brought to us. Landings make quite a difference in the cost of a stair, and in making an estimate for this sort of a stairway it is best to figure each short flight separately, charging per step as given in the foregoing figures, then make a special estimate of the landings, including joists, flooring, extra newels, rail and balusters and cost of labor. A fair idea of the cost of landings may be gathered from the cost of the flights. If the work on the stairs is done in the Colonial style, which is now so fashionable, an addition of from 5 to 10 per cent. extra should be charged for the labor, as more time will be taken up in preparing this style of work than is usual with other work.

Hard Wood Stairways.

If a stairway is constructed altogether of hard wood, and is to be finished in its natural state, the cost will be about double, as the most perfect workmanship and faultless materials must be employed, while at the same time the greatest of care must be exercised in protecting the work from stains or injury during the construction. If the rails are made extra heavy or double, the newels fluted and hand wrought, extra charges must be made proportionate to the extra labor required to perform the work. Rails of any required section may be obtained ready made by the foot at prices varying from 8 cents to $2. Balusters of all sizes and shapes, in any usable material, sell at from 8 to 90 cents each, according to whether they are round, square, octagonal, spiral or hand wrought or swash turned.

Newels in all hard woods, turned, carved, spiral or built up, may be had at from $4 to $5 each. Unless the estimator owns a factory and machines, or is too far removed from one, he will find it to his interest to purchase his stair furniture at the factory rather than attempt to make it himself, and his estimate will be more certain when he knows exactly for what he can get the work done, as he may by consulting the manufacturers' catalogue and price-list.

It is worth from $6 to $25 to set up a rail for a flight of stairs, including fixing newels and balusters. In setting up stairs between partitions, from 2 feet 6 inches to 3 feet 6 inches, with 7 to 10 inch treads and 6½ to 8 inch rise, the labor will cost 30 cents per riser, exclusive of preparing the stuff. Winding stairs of same dimensions 45 cents per riser. Open, straight stairs with risers, 6½ to 8 inches, treads, 7 to 11 inches, housed wall string, mitered cut string, molded nosings, brackets, making and fixing carriage, and leaving all ready for rail and newels, will cost for labor 90 cents to $1.25 per riser. The same stairs having winders will call for a charge of $1 for flyers and $2 for winders. The construction of dog legged stairs for back or attic stairs calls for a charge which may be 25 per cent. less than for stairs in more prominent places.

Steps and Stairs for Cellars, Porches, Etc.

Stairs or steps for cellars with 7-foot ceiling are worth for labor from $1.50 to $6 a flight. If without risers and have open strings, $1.50 to $2 will cover the cost of labor, but if strings are housed and furnished with risers, the labor will increase to $5 or $6. Steps and stairs for verandas, porches and stoops will require special estimates for each design. It may be put down, however, that the labor on this kind of work for the stairs alone without rail or paneled sides is worth from $3 to 15 cents per foot, running measure, on the length of the tread. If strings are square cut, 1½-inch tread, ⅞-inch riser, with planted cove under nosing and no return, the cost of labor, including making and fixing in place, will be 3 cents per foot for steps 6 feet or more in length and 4 cents per foot if under 6 feet. Thus a flight 10 feet wide having five steps will cost for labor $1.50 to make and fix, the stuff to be all mill-dressed.

There are so many styles of stairs and so many conditions attached to them that little can be offered in the way of a general rule for arriving at the cost of all sorts. Each stair should be estimated for itself alone, when the style, character and conditions are known, to insure anything like a certainty of cost.

Balusters, Newels, Etc.

It is also impossible to quote prices for balusters, newels and rails that will accord with the prices obtained in different sections of the country. We give a few, however, more as guides where local prices cannot be obtained, rather than as prices to be followed where there is a chance of getting current quotations.

Newel posts, plain turned, made of cherry, black birch, oak or ash, 5 inches in diameter, with cap, are worth $3; if 6 inches in diameter, with cap, complete, they are worth $3.50; if 8 inches, $4.

Octagon posts, made of the above materials, with ornamental cap, are worth, each, 8 inches diameter, $7; 9 inches diameter, $8; 12 inches diameter, $10.

Newel posts, veneered with fancy woods, with carved plinth and cap, molded side panels, are worth all the way from $15 to $75 each, according to the amount of work on them.

Plain balusters, turned, of material as the foregoing, 1½ x 1½ inches, are worth 7 cents each; 2 x 2 inches, 12 cents each; 2½ x 2½ inches, 16 cents each. Fluted or octagon balusters, 2 x 2 inches, 16 cents; 2½ x 2½ inches, 20 cents; 3 x 3 inches, 28 cents. Fancy balusters for first-class stairs, made spiral or carved, may cost anywhere from 25 cents to $1 each. Balusters for Colonial work, which at this writing is the prevailing style for domestic buildings, are worth from 8 to 15 cents each.

Stair rails of every conceivable section may be obtained from any well appointed factory and the prices will run per foot, for straight rail, 3½-inch section, 12 cents; 4-inch section, 15 cents; 4½-inch section, 17 cents; 5-inch section, 25 cents. Raised toad back rails cost about 25 per cent. more per foot, and fancy raised back rails, with 6 or 7 inch sections, will vary from 50 cents to $1 per foot, running measure. Ramps, goose necks, twists and level turns in a rail will cost from $1.50 to $5 per foot, according to the character of the work. Where possible this work should be given out to a professional stair builder and the cost ascertained before the contract is taken.

Since these figures were obtained there has been a general advance in prices of about 15 per cent. in all hardwood stairwork in New York, Chicago, San Francisco, Boston and some other of the larger cities. So far as I can learn, the advance in prices in the smaller towns has not been nearly so great in either materials or labor, though the larger cities generally set the pace in prices for the smaller towns. There are conditions sometimes, however, that cause considerable differences in prices.

Plastering

Generally the contractor sublets all the plastering and stucco cornice work that is to be done on any job he may have in hand, but that does not do away with the necessity of the contractor knowing how many yards of plastering for which he must provide, or feet of stucco cornice called for by the specification, and the prices of same. Usually plastering is done by the yard, and varies as to cost from 18 to 35 cents per yard, according to locality, cost of material and labor. As a rule, when materials are high labor is also high. Something also depends on the class of work. If three-coat work, the cost will be from 3 to 5 cents per yard more than if two-coat work. If the last coat is "hard finish"—that is, finished with plaster of Paris—it will cost from 2 to 10 cents per yard more than if finished in lime. It will take about 18 laths 1¼ inches wide and 4 feet long to cover 1 yard, and 1000 yards will require about 6½ pounds of threepenny nails to fasten them on. The average cost of lathing, including all material for the purpose, after the walls are properly prepared, is at the rate of 3 cents, if the work is done in an ordinary building. In public buildings, churches, halls, and where much scaffolding is required, the cost, of course, will be much more. If wire or expanded metal lathing is used, which is sometimes the case, the cost will increase over the foregoing from 25 to 40 cents per yard.

In estimating the number of yards of plastering in any building, local usage regarding openings and untoward places will have to be considered. In some places openings are not deducted at all; in others half the openings are allowed to the plasterer; while in others all openings covering 7 yards and over are deducted, counting both sides of doorways, and all openings under 7 yards are claimed by the plasterer.

Returns of chimney breasts, pilasters and all strips less than 12 inches wide should be measured as 1 foot, and when the plastering is finished down to the wainscoting, or base, 6 inches should be added to the hight of the walls.

Closets, raking ceilings, stair soffits and other similar work should have 50 per cent. added to the measurement. Circular or elliptical work should be doubled in price, and domes, groined ceilings and small oriels should be charged three prices.

"In stucco work, all moldings less than 1 foot in girt should be rated as 1 foot; over 1 foot to be taken as superficial. When work requires two molds to run the same cornice, add one fifth. For each internal angle or miter add 1 foot to length of cornice; and for each external angle add two feet. All small sections of cornice less than 12 inches long rate at 12 inches. For raking cornices, add one-half; circular or elliptical work, double price; domes, groins and similar work, three prices."

For enrichments of all kinds get prices from stucco worker before closing estimate. For all odd jobs of plastering, such as coating roof before shingling, rendering cellar walls or lining cisterns, make sure of prices before tender is finally submitted.

In order that the estimator may be able to know nearly the actual cost of plastering 100 yards, independent of the plasterer, we have prepared the following table, to which he can add the cost of labor and materials as they obtain in his locality:

AMOUNT OF MATERIAL REQUIRED TO PLASTER 100 YARDS, THREE-COAT WORK.

Seven bushels of lime, at	$......
Four-fifths of a load of sand at	......
Nine pounds of hair, at	......
1800 laths in place, at	......
6½ pounds of threepenny nails, at	......
Plastering 2 coats; 1 man 2-3 of a day, at	......
Helper, 1-5 of a day, at	......
Plaster of Paris	......
Hard finishing, 1 day, at	......
Making mortar and scaffolding, ¾ day, at	......
Total	$......

As the amount of plaster of paris used varies with different workmen, and also with the quality of the "putty" employed, we have left that item to be filled in according to the local usage.

If the estimator will copy this table into his memorandum book, and add the exact cost of materials and labor current in his neighborhood, he will always have for handy reference the exact cost of 100 yards of plastering in three-coat work.

Painting.

Painting is usually done by the yard, the same as plastering, with the exception that the painter receives no advantages of openings. At this writing, and with paints at the present prices, the average price throughout the country, as near as it is possible to obtain, for plain colors and plain work, is, for one coat, 8 cents per yard; two coats, 16 cents per yard; three coats, 22 cents per yard. These figures, it must be understood, are subject to change, as the prices of paint vary, and labor is equally changeable; but the figures will stand as a guide in the absence of the local quotations. In all cases, as before stated, the estimator should procure local bids per yard for all work of this kind.

The amount of materials required to paint 100 yards of plain surface is given herewith. For priming or first coating it will require 20 pounds of white lead and 4 gallons of linseed oil; for two coat work, 40 pounds of white lead and 8 gallons of oil; for three coat work, 55 pounds of white lead and 12 gallons of linseed oil. Coloring matter, of course, will have to be added when required, but as the common colors are cheap, they will add but little to the cost of the whole. A fair estimate for 100 yards of painting three coat work, so far as material is concerned, will be 55 pounds of white lead, 12 gallons of linseed oil, 1 pound of putty, ½ pint of knotting and from 2 to 4 pounds of coloring pigment when colors are wanted.

From these figures the estimator may be able to obtain pretty close quantites of materials required.

Day's Work in Outside Painting.

A day's work in painting outside a two-story frame building is 100 yards—including knotting—for priming coat, and 80 yards for either second or third coat, which, of course, includes "puttying" up and doing whatever sandpapering may be required. The work in all cases is supposed to be done without being obliged to build scaffolding. An ordinary door, including casings, will on both sides make from 8 to 10 yards of painting, or say 5 yards to each door without jambs or casings. The style of finish on architrave will regulate to a large extent the surface measure of jambs and trimmings, as it must be understood that the painter is entitled to pay for all quirks, edges and undulations in moldings. For instance, his measurements are made with a tape line held against the wall on one side of the doorway, and the line is then pressed into all the quirks, beads, bends, rebates and moldings, and is continued round the jamb to the opposite side of the doorway until the wall is again reached. This measurement, which gives the surface of the jamb and casings, is multiplied by the hight of the doorway to top of casings, and the result is then multiplied by two, which gives both sides of the doorway. To this must be added the surface measurement of the top trimming, which is the sectional measurement as obtained with the tape line multiplied by the exact opening of the doorway.

We have been a little particular on this point, as in our experience we have had several disputes to settle on this question of measuring the surface of door and window trimmings, when the painter has claimed the right to exact pay for the doorway measured from the floor to top of casings, and also for width of doorway over all, which was manifestly wrong, as that system would give him the surface measurement of the corner blocking twice, which in deep finish would mean often 1½ yards extra to one doorway, and many dollars when many doors were employed.

An ordinary window, casings included, has about 3½ yards of surface to cover on the inside; this, of course, includes cutting in sashes.

When graining is done, a good day's work for one man is 50 yards, and it will require another man one day to "rub in," so that in estimating it is the better way to allow 25 yards of graining as one day's work.

Measuring Outside Work.

In measuring up outside work use a tape line, bending it around every molding, as explained in the measurement of doorways. Commence directly under the shingles, lapping the line in the crown mold, fillet, fascia, planceer, bed mold, and all other members, and bending it over the edges of the siding or clapboards as you come down the building, then over the cap of water table until the foundation is reached, if painted so low down. This will give the hight of building, which must be multiplied by the length of the side, which is obtained in like manner by the use of the tape line.

If there are brackets on the building they are generally measured separately, and one-half more than actual measurement is allowed. These measurements, of course, are to be taken after the building is up, and do not fill the bill for the estimator, who must know the figures of surface measurement before he tenders for the work. They are given, however, in order that he may know what the painter will demand, and will guide him in making his estimate.

Twelve pairs of blinds of the ordinary size take a day's work by one good man to paint one coat, and it will take 9 pounds of white lead and 1 gallon of linseed oil, with the necessary coloring mixture, to do the work. Special work, such as gilding, striping, lettering, or other similar work, will always be a matter of special contract.

In measuring base, the painter claims 1 foot for all 12 inches or under, down to 9 inches; and 9 inches for all under that width.

It is not intended in these remarks to give rules for estimating hard wood finishing, though we are well aware that of late years nearly every house of any pretensions that has been built has its hall and one or two rooms fitted up with hard wood, a custom to be commended in many ways; and in order to give the estimator some data to work upon we may state that as a rule the cost of hard wood finish is from two to two and a half times more than a similar finish would be if done in pine or the softer woods. The ordinary hard woods—ash, sycamore, birch, beech and red oak—will cost about twice as much as ordinary pine finish, while white and black oak, cherry, and the finer grades of black birch and maple will cost two and a half to three times as much as pine. The more costly woods, such as mahogany, satinwood, burl walnut, etc., are so little used in plebeian dwellings that it is not our province at this time to do more than give them a passing notice.

Estimating a Brick House.

The Cellar.

Excavating.

In this case we are supposed to have the plans and specifications before us, so that we may be enabled to see on paper most of the items on which we are to figure. In order, therefore, to make the process of estimating as simple and as easy as possible, we reproduce the drawings of the brick residence designed by Grodavent Brothers, of Denver, Col., and published in *Carpentry and Building* some time since, together with a number of details and a brief extract from the specifications. The front elevation and section are given in Figs. 1 and 2. In the extract referred to it is stated the foundation walls are built of " hard burned bricks," and that " the exterior is faced with golden red pressed brick laid in colored mortar." In making this estimate we will provide for the foundation walls to be built of quarried stone instead of brick, and for the exterior walls we will simply give the number of bricks required to complete the work, showing the difference in cost of labor between laying ordinary facing bricks in plain mortar and pressed bricks in colored mortar. The estimator can readily find the difference of cost in his own locality between the qualities of bricks employed.

As the heating, plumbing and water supply come under departments, we will not deal with them here, and will make no further reference to them than is already made in the plans. There are also some other minor matters in

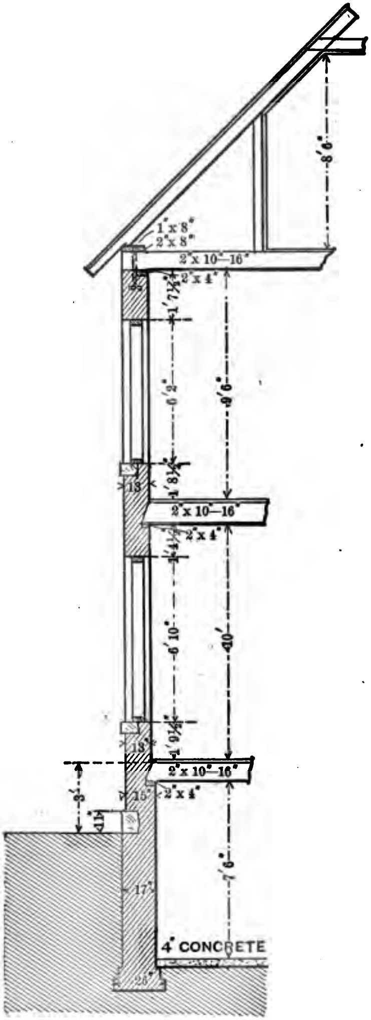

Fig. 2.—Section.—Scale, ⅛ Inch to the Foot.

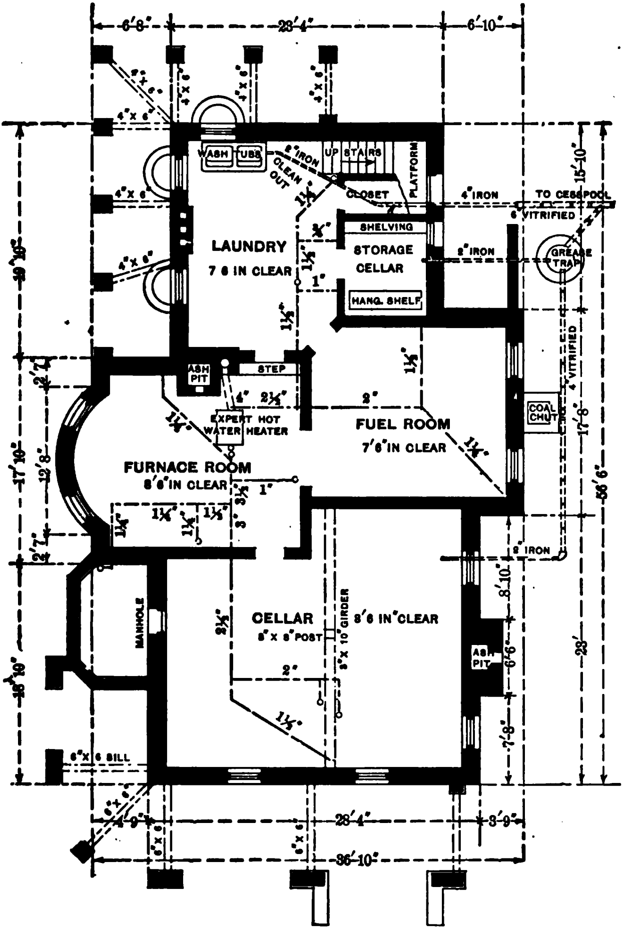

Fig. 3.—Foundation.—Scale, 1-16 *Inch to the Foot.*

connection with the designs that may be necessary to alter, and which will be fully explained as they are discussed.

The Foundations.

The illustration given in Fig. 3 shows the shape, lines and dimensions of the foundation, also sizes of the various rooms in the cellar. It will be noticed that all the earth to a depth of 5 feet has been removed from the whole area inclosed by the main walls. It now remains to find how many yards of excavating will be required to prepare the whole area for the concrete flooring and the stone work. By actual measurement we find that the main walls, including their own thickness, inclose an area of 1641 feet. It must be remembered we have measured the circular projection shown in the furnace room as being a straight wall on a line with its extreme projection. If we take 1641 feet, the area to be excavated, and multiply the figures by 5 feet, the depth of excavation, and then divide by 27 feet, the number of cubic feet in each cubic yard, we obtain the following results: $1641 \times 5 = 8205 \div 27 = 303\frac{24}{27}$, or in whole figures, 304 yards of excavating. This number of yards, however, does not represent the whole of the excavating, as we have the footings of the main walls to provide for, which are sunk 1 foot below the cellar floor and are 2 feet wide. By running a tape line all around the walls, allowing double for corners, we have $195 \times 2 = 390$ feet $\div 27$ = say 15 yards. Then we must add for dwarf walls under conservatory, back porch, foundations for veranda supports, footings for projecting chimneys, and other excavations 24 yards, allowing one yard for each footing for veranda posts. Now we have a total of 304 + 15 + 24 = 343 cubic yards of earth requiring to be removed.

The cost per yard of removing this material will depend largely on the quality of the earth and the distance the stuff has to be conveyed. If the material is used to grade about the foundation walls and just thrown out of the cellar, it will be worth per yard, for sand, 20 cents; gravel, 21 cents; loam, 22 cents, and for hard, stiff clay, from 23 to 28 cents per yard. If grading is done by the contractor, he should add from 3 to 5 cents per yard extra for this work. In excavating for drain tiles, cesspools, cisterns or other like work, double the above prices should be included. Another matter to be considered is that if the lines of the walls have to be laid out by the contractor he must make allowance for this time and charge accordingly. The cost of excavation as charged in the foregoing includes the furnishing of all plant required for the work by the contractor.

The cross walls and partitions in the cellar, as shown on the basement plan, Fig. 3, may be of studding, lathed and plastered, or may be formed of bricks resting on stone footings. For our purpose, however, we will suppose them to be made of 2 x 6 inch studding, lathed and plastered on both sides, with 6 x 8 inch posts placed in the walls where supports for girders are necessary.

Cost of Foundation Walls.

We will now see what the foundation walls should cost, including dwarf walls for back stoop, conservatory and footings for chimney stacks and veranda posts. In following the figures closely, as shown on the basement plan, Fig. 3, we find the footings of the main walls, including footings for chimneys, to measure 218 feet. This, of course, covers the projections of footings all around, also projections of chimney shafts. As the house is not a very heavy one, we will make the footings project beyond the walls on both sides 5 inches; then if we make the walls 20 inches thick, we shall have 30 inches, or 2 feet 6 inches, for the width of the footings carrying the main walls. These footings will extend 1 foot below the cellar floor, which will give in this case a block of masonry 218 feet long, 1 foot thick and 2 feet six inches wide, the solid contents of which will be 545 feet. To this add the extra footings required for the chimneys, which will be about 25 cubic feet. Then we have the foundation footings under the conservatory, back stoop and veranda supports, which by actual measurement aggregate 76 cubic feet. These quantities added together give 646 cubic feet of stone work in the footings.

It will be seen that we have left the footings 1 foot in thickness throughout the entire length, though as a matter of fact, if the footing stones are not more than 6 inches thick the mason "takes in" or narrows the wall somewhat upon laying the second course of footings. Thus the bottom course will be 30 inches wide and the second course may be 24 inches or even less in width, but in estimating it is usual to figure the whole width of lower footing until the top of the cellar floor is reached, and justly so, because the lower course often exceeds in width the specified dimensions, and there is considerable cutting and waste in the two courses. This explanation is deemed necessary because in most cases the contracts given do not conform with the drawings.

We will next find the cubical contents of masonry in the main and dwarf walls. The hight of the cellar from cement floor to joist is 7 feet 6 inches in the clear. We shall run our stone work to the underside of the main joist, thus giving 7 feet 6 inches of masonry to build on the top of the footings of the main wall. According to the figures we have a continuous wall to build 218 feet long, 7 feet 6 inches high and 20 inches thick, which contains 2725 cubic feet nearly. To this we must add the dwarf walls that carry the back porch and the conservatory. By measurement we find these walls to be 3 feet 6 inches high above the footings, 26 feet long and 20 inches thick, giving 117 cubic feet.

We now have all the stone work in hand, which, summed up, is as follows: Footings, 646, plus the main wall 2725, plus the dwarf walls 117, equal 3371 cubic feet. As a cord of stone when measured in the walls equals 100 feet we find that to build the foundation walls of the house under consideration will require about $28^{72}/_{100}$ cords of quarried stone. While a cord of stone in the rough pile is measured at 128 feet, it will not measure any more in the wall than 100 feet, and it is usual for mason's work to be so measured and estimated—that is, a cord of loose stones must consist of 128 feet, but a cord of stone measured in the wall is 100 cubic feet, In some sections of the country stone work is measured by the perch and not by the cord. A perch of stone in the wall measures 24¾ feet, but it is generally considered as 25 cubic feet. The estimator will have no difficulty in reducing the cords to perches or in making the perches into cords.

Measuring Stone Work.

In measuring the stone work it will be noticed that all corners are figured twice—that is, the length of the wall is taken from the outside. A tape line held at one corner and carried all round the wall, being forced into every angle and corner and wrapping round every point until the whole building has been gone over, is the usual way for masons to measure their work. This, it will be seen, measures the external angles twice, a custom always allowed because of extra waste and trouble in building up a corner in stone work. The openings, of which there are 14 in this foundation, have not been deducted from the above, as it is usual in most places to count undressed rubble work solid throughout, as the cutting and trimming for jambs, lintels and sills more than make up for any saving in material or labor required to make solid the openings. Sometimes, however, an agreement is made by which the openings are not counted, but under such agreement the mason is supposed to get a better price for his solid wall. Where the openings are 3 x 5 feet or less, the material man in many localities gets paid for the stone in the wall counted as solid throughout. In openings larger than 3 x 5 feet half of them are allowed for. These matters, however, are governed by custom, and custom makes law, for we have known judges in many instances to rule in favor of local custom when such ruling was in direct variance with previous rulings in similar cases in other localities. The wise tenderer will see to it that the matter of openings is settled before he sublets the building of the foundation walls.

Prices of Stone Work.

Now as to price: This is a matter that can only be decided upon by conditions obtaining in the neighborhood where the work is done. The prices prevailing in the town where these articles are prepared, based on a wage rate of $3.50 per diem of nine hours for mason work and $1.50 per diem for laborer, and the style of work intended —*i. e.*, undressed random rubble, including cost of mortar, pointing and lining up outside, and rough pointing inside—are $8 to $12 per cord of 100 feet laid in the wall. Tooled freestone sills, when such are used, are charged extra and the carpenter is expected to set all frames, place all bond timbers and lay all joists. The stone generally employed is a hard blue limestone, somewhat difficult to work. In some parts of New Jersey a sandstone is used which is very easy to work, and we have known of contracts being let at $6.50 per cord of 100 feet laid in the wall, while in other cases contracts have been let as high as $16 per cord of 100 feet in the wall.

Concreting Cellar Floor.

While it is not customary to concrete and finish a cellar floor until the building is inclosed, yet for convenience in this special case we will suppose the floor to be completed before commencing the superstructure. According to the extract taken from the specification the cellar floor is concreted 4 inches thick. There is no provision apparently for drainage or prevention of damp. In this estimate, however, we will provide for drainage of cellar, also for having a smoother and better floor than a concrete one, but these additions need not prevent the estimator from arriving at an approximate cost of the work in either case. By actual measurement we find the total area of the cellar floor contained inside the main walls to be 1341 feet, or 149 yards. If concrete only is used, consisting of 1 part of Portland cement, 2½ parts of sand, 3 parts of gravel and 5 parts of broken stone, which is according to Kidder, a good authority, the cost of properly laying, tamping and finishing will be about 60 cents a yard, the concrete to be 4 inches thick. If this is finished over while wet with good Portland cement and sand, 1 part of the former and 2 parts of the latter, and well troweled, made smooth and level, it will be worth about $1 per yard, at the present cost of a first-class brand of cement and wages at $3.50 and $1.50 per day. The ordinary concrete will make a good solid floor if properly done, but it will be rough and somewhat uneven. The latter, however, will make a floor as hard as stone and as smooth as a planed board. Both will be water proof so far as they are concerned, and if the cellar is well drained either floor will be perfectly dry.

Draining Cellar.

If the excavation is made in a moist spot or water rises above the floor level during wet seasons, then the cellar should be drained or water will surely rise above the floor at such rainy times. In order to do this properly "weeping" tiles should be laid in the floor and graded to the main drain, where a catch-basin should be placed into which the drainage will flow and find its way into the main drain, which must be connected to the catch-basin somewhat lower than the weeping tiles. In this cellar about three lines of weeping tiles will be sufficient unless a great in-flow of water is to be provided for. These weeping tiles are simply common field drainage tiles, such as farmers make use of in agricultural drainage. They cost from 3 to 8 cents a foot. The joints simply butt, which gives the water a chance to get in and away. There is a flat side to these tiles, and it is on that side they rest on the ground. When properly placed a layer of coarse gravel about 2 inches thick should be filled in between them, and on this from 4 to 5 inches of concrete, as specified, should be laid, according to one or the other of the methods mentioned. The addition of weeping tiles and gravel will add to the cost about 18 cents per yard.

It will be well also when water is a trouble in this matter to place a line of weeping tiles of large size all around the building just below the line of footings, grading them to the main drain and covering them with coarse gravel to the level of the footings. This would prevent water from getting under the footings and causing damp and decaying walls. For tiles and cost of putting them in place for this service, including cost of gravel, the figure will be in the neighborhood of 14 cents per running foot, the amount being about equally divided between labor and material. The estimator is cautioned against accepting these prices, if local prices can possibly be obtained. He may rely with a reasonable amount of confidence on the quantities, for these are constant, whereas prices are variable.

Ashlar Facing.

In case that portion of the wall showing above the grade is to have an ashlar facing the cost of the work will be very much enhanced, and in order to arm the estimator with the necessary knowledge to figure correctly on the various styles of ashlar facings it is necessary to place the following remarks before him: In granite ashlar where two stones measure 1 cubic yard the cost per yard will be $25 nearly. If smaller stones are used more dressing will be required, and the cost may run up to $35 per cubic yard. If sandstone is used to make ashlar faced masonry, it will be found to average about $17 per cubic yard. Sometimes these ashlars are very thin, being not more than 4 or 5 inches in thickness and backed up with common rubble of small stones. When this is the case the rubble work should be estimated at the regular rate for that work and the ashlars should be estimated at their actual value and quantity. This will lower the cost very much. Of course all ashlars, thick or thin, should lie on their natural beds.

Other building stones, imported or otherwise, must be charged in accordance with local rates, and these will range between $35 and $10 per cubic yard, with the exception of the marbles, which are high priced. The style of ashlar employed will also affect the cost to some extent. The style may be rock-face, which is cheap and effective, or it may be rock-face with angle-draft, or rock-face with draft line. Then there is pointed work, tooth-chiseled, tool-worked, drove-worked, rough-pointed, bush-hammered, fine-pointed, picked-work, rubble-work and many other styles, the cost of preparing differing more or less with each style.

With these figures and remarks before him the estimator should experience little or no difficulty in making a correct estimate of the cost of the cellar so far as we have gone, bearing in mind always that local prices in all cases should be used when obtainable in the place of those suggested herewith.

Damp Course.

It will now be in order to lay a damp course on the stone wall of either slate well bedded in cement mortar, a layer of asphalt ½ inch thick, or a layer of neat cement pure and simple. If slate is used, which is the best material of the three, it will take nearly two squares (195 feet) to cover the wall. These cost, say, $7 per square on the ground, and it will take about one barrel of cement and a couple of loads of sand to make the necessary bedding for the slate. The cost of these is easily obtained, and the labor of preparing mortar and laying slate and preparing wall for bricks and joists will cost one day's work for mason and one day's work for helper. Therefore, to arrive at the estimated cost, we have:

2 squares of slates, at..............................	$......
2 loads of sharp sand, at............................	......
1 day's work for mason, at..........................	......
1 barrel of cement, at..............................	......
Total...	$......

The blanks should be filled in with the actual cost of material and labor current in the neighborhood where the work is to be executed.

The Superstructure.

We are now ready to start operations on the superstructure, as we will leave the partitions, joists and other work in the cellar to be estimated on at a later period. There is considerable stone work required for window sills, door sills, window caps or lintels and bonding stone in chimney. In the cellar there are 13 windows, each with sills 3 feet 6 inches long and 6 inches thick. These would make a total length of 45 feet 6 inches for sills required for the cellar windows. If cut from freestone and tooled, they will be worth about 80 cents per foot running measure, and something less if the stone is "rock-face." There will also be about the same length of wrought stone for lintels. This, however, will be worth from 15 to 20 cents per foot more because of its greater width, being about 1 foot in width, and in this case cut with a curve to suit the top casing of frame. If left parallel the cost will be something less.

The stone sills and lintels required on the main floor measure 47 feet 6 inches. This includes the circular sills in the bay window. The price of these sills will be the same as the price of those in the cellar windows. The lintels will also be 47 feet 6 inches long, and the same price as lintels in the cellar per foot. The second-story sills measure 59 feet 6 inches, so also do the second story caps or lintels. Of course, these stones will cost at the same rate per foot as those already mentioned, and, while I have given a price, it must be understood that the prices of this stuff should be ascertained at the place where the work is to be done, and should include delivery on the ground.

In the building before us the drawings show a stone plinth just above the ground level or grade. We will dispense with that, but if it should be necessary to make an estimate to put in a similar plinth, the allowance of $1 per foot, running measure, will cover the cost in the locality where this is written.

It will require 10 feet 6 inches of door sills, these being 14 x 6 inches, and will cost not less than $1 per foot, running measure, when laid in the wall. Besides these we will be obliged to furnish cut stone for the plinth in the chimney; also bonding stone at the top of the batten in the chimney. This will make some 16 feet of cut stone, the average cost of which will be 70 cents per foot, making $11.20 for the whole amount of cut stone in the chimney.

Besides the bonding stones used in the lower portion of the chimneys, there are projecting courses of stone on the tops. These courses measure about two courses of bricks in thickness, and the three chimneys average 2 feet 6 inches by 4 feet 6 inches in section, making the number of feet of stone in each chimney, running measure, 11 feet, or 33 feet for the whole stone work required on chimney tops.

The items given of cut stone are all that are exhibited on the drawings and cover all the requirements the house needs in cut stone to make it solid, substantial and in good taste. Let me again repeat that the prices given herewith must only be used when local prices cannot be obtained.

Figuring the Brick Work

We are now in a position to figure on the brick work, having shown how the quantity of stone for foundation walls was obtained, and made plain the method employed in finding the number of feet of cut stone used in the building under consideration.

An examination of the plan of the first floor, Fig. 4, will show us the lines on the outer walls that require to be of brick. These walls are marked on the plan as being one and one-half bricks in thickness, exclusive of inside rendering and furring, lathing and plastering. As bricks differ in size in different localities, it is difficult to lay down an exact rule for the thickness of the wall formed by making it one and one-half bricks thick. In the New England States the common brick averages 7¾ x 3¾ x 2½ inches, while in many of the Western States the bricks measure about 8½ x 4⅛ x 2½ inches, a difference that means a great deal in a building requiring 300,000 or 400,000 bricks. If the latter sizes are used the walls will measure about 9, 13, 18 and 22 inches in thickness if the bricks are laid one, one and a half, two and two and a half in the wall, and as one wall is one and a half bricks in thickness the wall will be 13 inches thick, exclusive of laths, plaster and furring. According to Kidder, in "Building Construction," page 246, vol. 1, "Brick work is generally measured by the 1000 bricks laid in the wall. The usual custom of brick masons is to take the outside superficial area of the wall (so that the corners are measured twice) and multiply by 15 for an 8 or 9 inch wall, 22½ for a 12 or 13 inch wall and 30 for a 16 or 18 inch wall, the result being in bricks. These figures give about the actual num-

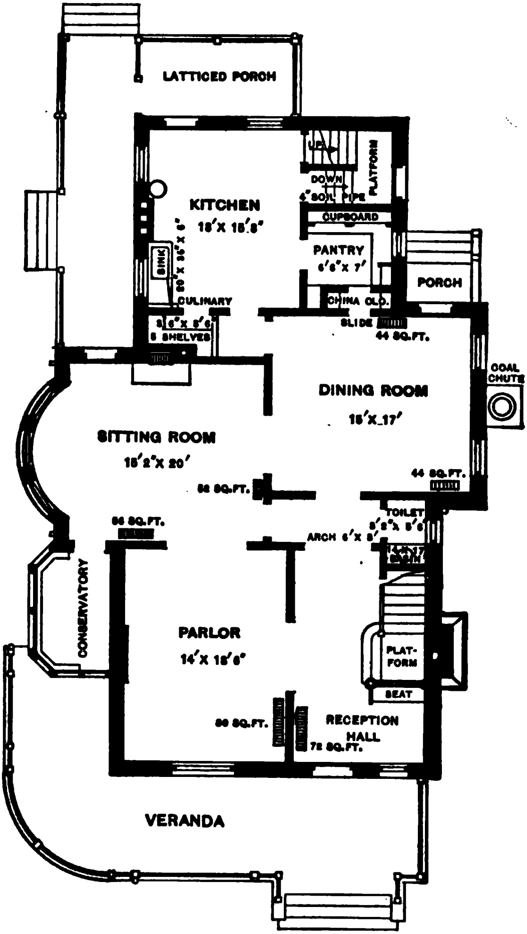

Fig. 4.—First Floor.—Scale, 1-16 *Inch to the Foot.*

ber of bricks required to build the wall in the Eastern States, but in the Western States, where the bricks are larger, they give about one-third more than the actual number of bricks contained in the wall, and the price is regulated accordingly."

According to this rule, a superficial foot of brick work, when the wall is one and one-half bricks thick, as ours is supposed to be, will contain two-thirds of 22½ bricks, which equals 15 bricks to the superficial foot of the wall. In a long experience we have found that this figure does not give enough, and the contractor who figures on this basis will very likely find out, if he does the work, that his expenses for brick work were more than he expected. We have found that in estimating for brick walls 13 inches thick, multiplying by 17 gave results much nearer the actual brick required than by using the figure 15, and in making up this estimate 17 is the figure we will employ.

Another matter.we must consider is that of the openings. We again quote from Kidder: " In regard to deducting for the openings, custom varies in different localities, but unless the openings are unusually large no deduction is generally made for common brick work." In this our authority is right. Without the openings are large there should be no deductions, as the waste in cutting and trimming around window frames fully makes up for any bricks unused in the openings; and in the building before us we will make no deductions, only for the larger windows and doors. Keeping these rules in view throughout the whole of the estimating of this building, we will be able to arrive at a pretty correct estimate of the cost of the work when completed.

Quantity of Brick in Walls.

We will now see how many bricks there are in the front wall, inclosing parlor and reception hall. This wall measures in round figures 28 feet on the face, and is 23 feet high, including beam filling; therefore we have 23 × 28 = 644 superficial feet. As the two large windows have a combined area of 70 feet, and the two doors 40 feet, making altogether 111 feet, we will allow the owner one-half of these openings, or, say, 56 feet, which sum being deducted from 644 still leaves 588 feet of brick work to be counted. Now if we multiply this 588 feet by 17, the number of bricks in each foot of one and a half brick wall, we obtain the following result: 588 × 17 = 9996, which sum represents the number of bricks required to build the front portion of the house.

The right hand side of the house, by actual measurement, including offsets and projections, with the exception of the chimney, has a total length of wall of 67 feet and a hight of 23 feet; therefore we have 23 × 67 = 1541. The openings on this side of the house are not sufficiently large to come under the rule of dividing up with the owner, as the extra work required to build around them, and the waste, will fully counterbalance the saving in bricks. Now, taking the area of wall, 1541 feet, and multiplying by the constant 17, we have 17 × 1541 = 26,197, the number of bricks required to build the right hand side of the house. It will be noticed that the area of wall covered by the chimney is included in the figures given, a matter that requires some explanation at this point. If we refer to the plan, Fig. 4, it will be noticed that the wall passes through the chimney full thickness, with the exception of a small area at the flue, of which we take no notice. The projection of the chimney shaft beyond the wall will be a matter to be dealt with when the question of chimneys is considered.

On the rear wall we have the following measurements: 23 feet long and 23 feet high, which gives an area of 23 × 23 = 759, and as we do not allow anything for openings in this portion of the wall, we get 759 × 17 = 12,903, the number of bricks required to complete this wall.

The left hand wall, showing the circular bay in sitting room, is, without including the face of the projection showing the bay, 49 feet in length, and as those portions inclosing the parlor and kitchen are the same hight as the portions of wall already estimated, we will use the same hight for this wall, and will add the extra hight as shown on the front elevation, Fig. 1. This will give us 49 feet, the length of wall, and 23 feet, the hight of wall; 23 × 49 = 2127 feet of area; again 17 × 2127 = 36,159, the latter sum being the number of bricks required to complete the wall to a hight of 23 feet. To this must be added a wall 12 feet long and 6 feet high.

This additional wall is the upper portion of the projection shown at the sitting room, where the circular bay is exhibited. We have already counted in a part of this wall up to 23 feet in hight, but, as will be seen in the elevation referred to, this portion of wall is 29 feet high, so we must make provision for building the remaining 6 feet; therefore we have 6 × 12 = 72, the number of feet; then 17 × 72 gives us 1224 bricks, the number required to raise the projection to the proper hight.

To complete this side of the house we have yet to deal with the circular bay and the brick piers, quoins and butments connected with it. From a contractor's point of view the brick mason should be allowed to receive pay for this end of the projection as though it was solid, inasmuch as the waste and extra labor will cost as much, if not more, than would the extra bricks to make a solid wall. However, merely as a matter of practice for the reader, we will make an estimate of the number of bricks required to build up this end, taking out the openings; but while in this case we deduct the openings the young contractor must be cautioned against making this deduction in actual practice, as by doing so, and not providing for the loss in some other way, he will find at the end of his contract a shortage that may prove inconvenient, if nothing more.

In the circular bay we have two brick piers between the windows and two quoins and butments on the outer corners. The piers measure 2 feet on their faces, and taking upper and lower stories together, their hight will be for each 16 feet. This will give for area of piers 32 feet; therefore $17 \times 32 = 544$, which will be the number of bricks required to build the piers. Under and over the windows we have 40 feet in length, made up as follows: Each opening in the bay, clear of the brick work, measures 3 feet 4 inches, and there are three openings in each story, so that the combined openings, measured across the face, make exactly 20 feet, and as each window has a panel of brick work above and another below the sash, the whole measurement of brick panels above and below the openings will just make 40 feet in length. The total hight of this projection is 23 feet, but as the openings take off 16 feet of this, we have left for the combined width of the panels some 7 feet. Therefore we have the following: 7 × 40 = 280 feet of area, which gives 17 × 280 = 4760, the number of bricks required to build in the panels. Now the butments and quoins together measure 6 feet in length, and are, of course, 23 feet in hight; therefore 6 × 23 = 138, the area; this, then, gives us 17 × 138 = 2346, which represents the number of bricks required to build the butments and quoins. I recapitulate here the number of bricks required to build the left hand side of the house:

To build wall 23 feet high, as stated	36,159
To build additional wall or projection	1,224
To build two brick piers	544
To build for panels	4,760
To build butments and quoins	2,346
Total bricks required for left side	45,033

There is a porch entrance on the right side of the building where the steps leading in are inclosed with bricks. This inclosure, taking both sides, measures about 14 feet in area, which will require, to build, about 14 × 17 = 238 bricks. Brick work in and about verandas, porches and steps, not otherwise accounted for, makes about 40 feet area, which requires 17 × 40 = 680 bricks to complete.

Bricks in Chimney.

We still have the chimney to deal with. Already we have passed the walls through all the chimneys to a hight corresponding to the hight of the walls of the building. Starting with the large chimney on the right elevation, we find it has an area, measuring from the stone work to the plate, of 92 feet, and from the plate line to coping on top, 72 feet. This latter must be doubled, because the shaft, from the plate up, is double the thickness of the wall, and no deduction for wall has been made in the shafts above the plate, as has been the case with them below the plate. Doubling this 72, we get 144 feet, to which is added the 92 feet for the lower portion of the chimney, making 236 feet, which is the total area we have to figure on. From this we get: 17 × 236 = 4012, the number of bricks required to complete that chimney. The kitchen chimney, being the same size, requires the same number of bricks—namely, 4012—to build it.

The chimney showing a fireplace in the sitting room may be measured as double all the way up, as it is very much enlarged at its base in order to get in a good sized grate and ventilating flue. Its total hight is 40 feet, its width averages 4 feet, which makes a face area of 160 feet. It is made three bricks in thickness, which will make it as thick as a double wall if we leave out the unoccupied spaces left for the flues. In estimating, chimneys of this kind are figured on as being solid. Now, 160 doubled will give 320 as the area to be multiplied; therefore we get 17 × 320 = 5444 as the number of bricks required to build this chimney. From these figures we are enabled to tell how many bricks we require to complete the chimneys as shown in the plan. To repeat, we have for:

First chimney	4,012
Second chimney	4,012
Sitting room chimney	5,444
Making a total for chimneys of	13,468

Now we have the figures giving the total of bricks required to complete the house as we have described it. Here we recapitulate:

For front of house	9,996
For right side	26,197
For rear end	12,903
For left side	36,159
For around circular bay	8,874
For porch	238
For verandas	680
For chimneys	13,468
Total bricks required to complete the house	108,515

The reader will see that no provision is made in these figures for gables as the plans and elevations show all these finished in wood and shingled.

Rough Lumber Required.

We have now estimated on three classes of material for the house—namely, quarried stone for foundations, cut stone for trimmings, and for all the bricks required to complete the house in conformity with the plans as exhibited. It will now be in order to find out how much rough lumber, such as joists, studding, rafters, sills, wall plates and other similar material will be required.

An examination of the foundation plan, Fig. 3, will show that there are several verandas and porches to be timbered, and we will deal with these first. The front veranda measures 33 feet in length and 6 feet 6 inches in width. There are five sills 6 x 6 inches, 6 feet 6 inches long. Each one of these will contain 20 feet of stuff (nearly), board measure, or altogether 100 feet. Under the conservatory there are two sills 6 x 6 inches x 8 feet, which together measure 48 feet. On these sills we lay joists, 2 x 8 inches, 16 inches from centers. This will give us, as near as we can make the division, six courses of joists, for as 6 feet 6 inches will not divide up equally by 16 we place the centers a little closer together, and we are compelled to place a joist against the wall and one on the outside. As each course in front is 33 feet long by 2 x 8 inches, it will contain 44 feet, which gives us 44 × 6 = 264 feet. Under the conservatory and end veranda connecting with it we have seven courses of joists 18 feet long, 2 x 8 inches, which will give us 168 feet. On the same side of the house at the rear end, and on the rear end, is a veranda, which measures, all told, rear and side, 36 feet. This requires eight sills 6 feet long, 6 x 6 inches, which makes a total of 144 feet. This veranda will require five courses of joists 36 feet long, 2 x 8 inches, which makes 240 feet. These amounts cover the total joists and timber required for porches and verandas. To prevent mistakes, the items are called off again:

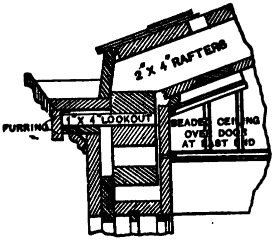

Fig. 5.—Details of Conservatory Cornice.—Scale, ¾ Inch to the Foot.

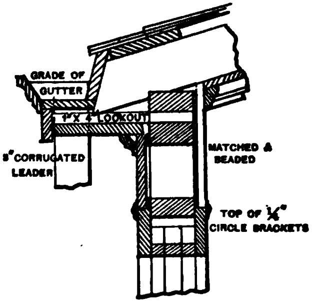

Fig. 6.—Details of Front Porch Cornice.—Scale, ¾ Inch to the Foot.

Front veranda sills	100 feet.
Sills under conservatory, etc	48 feet.
Joists under verandas	264 feet.
Under conservatory, etc	168 feet.
Rear veranda sills	144 feet.
Joists	240 feet.
Total for verandas, etc	964 feet.

It will require two days' labor to frame the sills, place them, cut the joists, put them in place and make them ready to receive the veranda floor. In work of this kind the estimator must reckon that to prepare and properly put in place 500 feet of rough joisting, sills and similar work requires a good man one day, and, taking all similar kinds of work into consideration, this time is little enough. The estimator must not overlook the nails required to make this work good. Experience shows that this sort of work averages something like 5 pounds of nails to every 1000 feet of joists and sills put down on what is known as the "rolling system;" that is, when the joists simply rest on the sills without being framed into them, which is the case with the ones under consideration

The Basement.

We must now deal with the cellar, furnace room, laundry and the basement generally. In this case we make all the partitions of wood and plaster. There is a beam and post in front cellar to carry floors above. This beam, or girder, is 24 feet long, 8 x 10 inches, and is held in place by two posts and the front brick wall. The posts are 10 x 10 inches, 8 feet long, and rest on good stone footings, which have been provided for. These posts will measure 134 feet, and the girder will contain 160 feet. There is now 83 feet of partition, 8 feet high, to be provided for. This will take 63 studs placed 16 inches to centers, 2 x 6 inches (we make these 2 x 6 inches in the basement, as these partitions will have to bear a goodly portion of the weight of the floors and partitions above); each stud will contain 8 feet, making a total of 63 × 8 = 504 feet. As this does not provide for double studs at the doors, floor pieces and plates, we may make the amount 700 feet, as that much will be required. To place these partitions and make them ready for the lathers, and put in posts and girder, will take two days' labor and 5 pounds of nails. All the joists in lower floor are 2 x 10 inches and of various lengths, but all placed 16 inches from center to center. By actual measurement these will require the following:

15 joists 2 x 10 inches x 12 feet =	300 feet.
15 joists 2 x 10 inches x 14 feet =	384 feet.
7 joists 2 x 10 inches x 17 feet =	168 feet.
14 joists 2 x 10 inches x 20 feet =	465 feet.
Which will make a total of	1,317 feet.
To this we may add for bridging	100 feet.
And for bond timber, strapping, etc	150 feet.
Making a total for skeleton of floor	1,567 feet.

We have made the joists the lengths given in order to have the flooring all run one way, which in this case will be from front to rear. If it is no object to have the floor all run one way the lengths of joists may be changed, but the amount required (board measure) will be the same.

As the dimensions of the joists in the second story and attic floors are the same, all we have to do is to add twice as much more to the foregoing figures in order to get the amount of flooring joists required to complete the house:

Example:

Joists for 1st floor	1,567 feet.
Joists for 2d floor	1,567 feet.
Joists for attic floor	1,567 feet.
Total joists required	4,701 feet.

This also includes bridging.

We find that it will require about 1200 feet of 2 x 6 inches of varying lengths for collar beams. It will require 45 pairs of rafters 2 x 6 inches, averaging 20 feet in length, for roof running from front to rear, and 21 pairs averaging 18 feet in length, making altogther:

90 rafters 2 x 6 inches x 20 feet =....................	1,800 feet.
42 rafters 2 x 6 inches x 18 feet =....................	756 feet.
Total number of feet (board measure)............	2,556

The figures so far given do not include rafters in porches, verandas or bay windows; we will deal with those separately.

Measuring over the roofs of porches, conservatory and verandas, we find all combined to be 96 feet in length, with rafters, hips and jacks or cripples spaced off to about 2 feet apart. This will give us 49 rafters having an average length of 10 feet. The rafters are marked 2 x 4 inches, which would make 6 feet 8 inches of board measure in each rafter; therefore, 49 × 6 feet 8 inches = 310 feet 8 inches, or, in round figures, 311 feet. Under balcony floor there are seven joists 2 x 8 inches, 10 feet long, which will make 94 feet; to this must be added 22 ceiling joists 5 feet long, 2 x 4 inches, in back veranda, which make up 70 feet more board measure. Add to these figures about 200 feet for bridging, blocking and waste, and we have for rough stuff above floors of verandas, porches, etc.: Rafters, 311 feet; balcony joists, 94 feet; ceiling joists, 70 feet; miscellaneous stuff, 200 feet, or a total of 675 feet.

There are wanted in this building four main gables which are formed of wood, shingled on the outside and lathed and plastered on the inside; and just here let it be stated that while it is usual to finish this style of gable as above we have found it gives much better satisfaction to build in bricks between the studding, making a solid 4-inch wall from the plate up. This is not an expensive measure, as the commonest sort of bricks may be used—providing they are sound, and the mortar and labor will not count up very much when the bricklayers are on the ground—but in this case we adhere to the spirit of the plans before us. The four gables taken together at their bases measure 184 feet, and they have an average hight from base to peak of 13 feet, which will give the average length of stud, say 7 feet. It will require 140 2 x 4 inch studs, including waste, which make in board measure 630 feet. For frames of entrance steps, lattice with veranda plates, and other like matters about the outside we may put down 500 feet, which is cutting the material pretty close.

Material for Partitions.

The next thing will be to discover the quantity of material required to set up all the partitions. In this case we are to understand that the partitions are formed of 2 x 4 inch scantlings with double studs at the sides of all openings and over the doors. By actual measurement we find that it will require 350 pieces of scantling 10 feet long to build all the partitions in the main and chamber floors. Thus number provides for double studs at the doors and double transom heads. For fear that we may not be properly understood with regard to the lengths of these studs, it will be noticed that the story in first floor measures 10 feet, while the second floor story only measures 9 feet 6 inches, but we have been obliged to count them as 10 feet, as this is the nearest standard length suitable for the purpose. This being cleared, we will now proceed to business: Three hundred and fifty pieces of scantling 2 x 4 inches x 10 feet = 2275 feet. In the attic there are 200 studs 2 x 4 inches, with an average length of 7 feet. This number will be ample for doorways and door heads. If for convenience we say 100 studs 2 x 4 inches, 14 feet long, for attic partitions, it will facilitate matters somewhat; therefore we have 100 2 x 4 inches x 14 feet = 975 feet.

We have now provided for all the rough dimension stuff in the building. The veranda posts, newels, plates and rails will come up under the head of dressed stuff. The roofing boards and the boarding over the gables, however, may be dealt with as rough stuff, and should be purchased the same per 1000 as dimension stuff; this will, of course, depend on local prices.

It will require to cover in the four main gables about 700 feet of rough boards—they would be better if run through a planer; and to cover the roof, not counting roofs of verandas or porches, it will take nearly 3500 feet. This will allow for waste in cutting on hips and valleys. If the inside of the gables is to be lined, then add 700 feet more to the above, and the contractor will find he will have enough stuff to complete the work for which it is provided if he is not too generous in its use.

According to details of parts of front porch and conservatory, as shown in Figs. 5 and 6, the roofs are covered with rough inch boards preparatory to shingling, so we must provide rough material for this purpose. The front veranda with balcony will require about 650 feet, including waste in cutting hips and around the circular corner. The back porch, including everything, will require about 600 feet.

All these measurements are taken from the plans and elevations, and the quantities are the results of these measurements and are offered as being nearly correct.

Cost of Labor.

We now have all the rough material on hand, and the next step is to find out how much labor it will take to place the stuff in position. In the first place, we should figure up how much rough stuff of each denomination we have on hand, which in this case is as follows:

6 x 6 inch sills for verandas	292 feet.
Joists throughout	9,293 feet.
Girders and posts	294 feet.
Scantling	4,384 feet.
Rafters, etc	2,867 feet.
Rough boarding	5,420 feet.
Total rough lumber	22,580 feet.

To set partitions, place joists, frame and set up rafters, put in sills, girders and posts and nail on all rough boarding is worth, averaging all around, 70 cents per square, and as there are 225 8-10 squares of rough lumber in the above, the amount for labor, at the rate of $3 per day of nine hours, will total up to $158.06. To this amount we must add cost of lumber and nails; the former will be fixed by local prices, and the latter by the nails used, which in this case will be about 20 pounds per 1000 feet on the average, or 450 pounds of nails to properly set in place and finish the 22,580 feet of rough stuff. From these figures, knowing all local prices, it will be an easy matter to get the cost of the building so far as estimated.

We have found in practice that the actual measurements as given in the foregoing do not make enough allowance for waste and culls, and we have therefore always made it a rule to add 5 per cent. to the totals of materials and labor. This 5 per cent. addition is for labor and material, and is not intended as profit. In nine cases out of ten it will be found that the addition is not one cent too much. Having all partitions set, joists laid and roof boarded, our next step will be to " fur " up the brick walls and make them ready for the lather.

Furring.

If the walls of the building are to be " rendered " on the inside, which, of course, ought to be done to make good work, the rendering should be done at least three or four days before the furring is nailed to the walls. It is supposed the carpenter has supplied the bricklayer with joint strips to build in the wall at regular intervals to which to nail the furring, so that there will be no trouble in making the furring secure. The furring should be not less than 1 inch thick and about 2 inches wide. It would be better, for several reasons, if it was 1½ inches thick; but as it is usual to make the furring 1 inch thick, we will take that for our standard. All furring, like studding, must be placed 16 inches from center to center in order to have 4 feet of lath work in properly. Each strip of furring will contain 1 foot and 8 inches of stuff, being 10 feet long and 1 x 2 inches. The inside of the walls, measuring all round the brick work, including projections and circular bay, make about 174 feet. The furring, placed 1 foot 4 inches on centers over this space, would require 131 pieces, and this would make 218 feet of stuff, board measure. As the second floor requires furring as well as the first, this amount must be doubled, making 436 feet; or, in round numbers, 500 feet. A man will nail on and true up about 75 pieces of furring in one day, but it is always better and speedier to have two men employed at this work, as one can be at the top, on a scaffold or ladder, and the other one at the bottom. As we have 131 pieces on each floor, or a total of 262 on both floors, it will take one man about three and a half days to fur the whole building. Besides this, it will take about 20 pounds of nails to fasten on the furring strips.

We might say, *en passant*, that the word "furring" is a corruption of "firring." In "ye olden" time brick and stone walls were finished up inside with fir poles, the faces of which, on the sides of the rooms, were hewn flat and true to receive the lath. Hence the term "firring," which is now corrupted to "furring." We have used the latter term because it is more generally understood, though we owe it to the language we speak to keep it pure if possible. We now have for furring, say 500 feet of stuff, three and a half days' work and 20 pounds of nails.

Grounds.

Next in order are the grounds on which to fasten the base, door and window trim and other wood work. All the stuff required for grounds must be brought to a thicknes, and should be of a better quality than anything on which we have thus far figured. Grounds may be 1½ inches wide, and from ¾ to 1 inch thick, as the case may be. It is doubtless unnecessary to warn the carpenter that the perfection and speed of the work depend largely on the manner in which the grounds are planted. Blunders in putting these in place mean loss of time and material when the finish is put in place, therefore it is always best to have an old and experienced hand to plant the grounds.

There are some 78 openings in the building, including windows and all doors inside and out, and other openings. All of these will require to have grounds, and the inside doors will require grounds on both sides, which will add 40 more openings, making a total of 118. It will take at least 2 feet of stuff for each opening, which would make 236 feet of dressed grounds for openings. Then, two courses of grounds for base and other finish round all walls and partitions would give us, by actual measurement, 744 feet, running measure, which would spoil another 100 feet of dressed stuff. It is therefore safe to figure on 350 feet of dressed stuff for grounds. It will take one man a full week to plant these grounds properly, and from 10 to 12 pounds of nails. We have, then, for grounds 350 feet of good dressed stuff, six days' work for one man and 12 pounds of nails. It is easy to get the cost from this.

As setting the window and door frames in the brick wall will come under the heads of windows and doors, we will omit them here and take up the roof covering and floors.

Covering the Roof.

It is quite obvious that we must be in a position to keep out the rain before we can lay our floors, plaster or put in place our finish, therefore we must cover the roof with some one of the usual coverings. It is better that a house of this kind be covered with slate or Spanish tiles, but these materials are so seldom used—more's the pity—that we must fall back on the shingles of our "daddies," which, when properly prepared and laid, do excellent service for their cost.

According to the figures already given, we have charged up the cutting and the placing of the rafters and collar beams and covering them with roof boarding, so what we have to do now is to cover the boards with paper—the author is not in favor of placing under the shingles a thin coat of mortar, but prefers paper—and then shingling over this. The estimator will, of course, be guided by the architect's specifications with regard to the kind of shingle he will use, and the architect will be compelled to specify such shingles as may be in common use in the neighborhood where the house is to be erected. He will also define how much of the shingle shall be laid to the weather. In this case we will adopt the rule that requires 1000 shingles to lay one square—namely, 4½ inches to the weather. If the specifications call for more or less than this number of inches to the weather, then the estimator must make the result to suit, which will be an easy matter, for if it is specified 5 inches to the weather, then it will require one-tenth less shingles, and if 4 inches to the weather, it will require one-eighth more shingles to cover the same space.

Roof Areas.

In the front gable we find the rafter to be 22 feet over all and the roof runs back to an average distance of 30 feet; therefore we have for the area of one side of the front roof 22 × 30 = 660 feet. This, then, for both sides of the roof would be 660 × 2 = 1320; or, in other words, it will require 13,200 shingles to cover the front part of the house. For that portion of the roof standing over the sitting room we have the following figures: Length of rafter, 15 feet; length of roof, average, 14 feet; therefore 14 × 15 = 210. This gives the area of one side of the roof; therefore 210 × 2 = 420 for the whole roof; or, in other words, it will require 4200 shingles to cover this portion.

Next we have the roof over the dining room. This has a rafter 15 feet long, and the average length of roof is 11 feet; therefore we have 15 × 11 = 165, the area of one side of this roof. For both sides we have 165 × 2 = 330—that is, it will take 3300 shingles to cover this portion of the roof. Now we have that portion of the roof that covers the kitchen to compute. Here we find the rafter to be 18 feet long and the average length of the roof to be 23 feet; therefore one side will give us 23 × 18 = 414 feet for one side; therefore 414 × 2 = 828 feet of area, or 8280 shingles will be required to cover the roof.

This completes the roof of the main building, so we will now take up the roofs of porches and verandas. The front veranda, without porch roof, is 36 feet, including bend, with a 10-foot rafter, which would give us 36 × 10 = 360 feet, requiring 3600 shingles to cover it. The upper porch in front contains 160 feet, requiring 1600 shingles to cover it. We have provided for the conservatory in the shingles covering the front veranda. The back veranda measures 34 feet around, taking a center line through both sides, and the rafter is 8 feet long; therefore we have 34 × 8 = 272 feet, which will require 2720 shingles to cover.

Shingles Required.

Now we have sufficient shingles to cover all the roofs; but these do not take in any shingling of the gables, ends of porches, verandas or other horizontal work. Hence we have the following for roof covering:

	Shingles.
Front roof	13,200
Roof over sitting room	4,200
Roof over dining room	3,300
Roof over kitchen	8,280
Front veranda	3,600
Upper porch	1,600
Rear veranda	2,720
Total to cover roofs	36,900

In round figures it will take 37,000 shingles to cover all the roofs on this building.

Besides the shingles it will require 4100 yards of paper to cover the same surface, without counting the lap necessary to make good work when laying the paper. This lap should run over at least 6 inches on every layer, which would make it one-sixth more, or 4784 yards of paper. While this is somewhat generous, it is not a bit too much to insure good work. It is very likely the architect will specify the paper to be used, and will, no doubt, call for some brand that is slow-burning. If he does not, it should be the duty of the estimator to figure for that sort of paper, and use it if he gets the work. It is worth about 25 cents a roll for laying the paper and 10 cents a roll for nails, making it worth 35 cents a roll. The cost of the paper must be obtained from local dealers. Here we have provided for a 6-inch lap. This is not imperative, as the lap may be increased or reduced to suit circumstances. If a roof is flat, or of low pitch, then the lap may be increased; if it is steep, then the lap may be reduced to 3 inches. Often the contractor will have no option in the matter, as the architect will specify the amount of lap.

The roof being covered, and the interior being protected from rain, we may now proceed to lay the floors and to make preparations for lathing and plastering. The floors may be of hardwood or of pine, and it will be the duty of the estimator to find out how much the cost per 1000 feet, surface measurement, will be, delivered at the building, allowances to be made for the quality of the stuff and for the thickness. It will be our duty to give the number of feet required to cover the floors of both stories and the floors of the verandas and porches.

Flooring Required.

Commencing with the first floor, we find by measurement that the parlor and reception hall with closet are 18 x 25 feet, leaving out the odd inches for convenience sake. This will require to cover the surface 450 feet. The sitting room is 15 x 20 feet; area, 300 feet; the dining room, 15 x 17 feet; area, 255 feet; passage with toilet room, 4 x 13 feet; area, 52 feet; kitchen, pantry and stairway, 15 x 20; area, 300 feet; passage and shelf room, 4 x 10 feet; area, 40 feet, making a total in surface feet of 1397 on the main floor. To this we must add at least 10 per cent. for waste in cutting, thus making a total of 1537 feet. If the flooring is wrought from 1-inch stuff it will require, in round figures, 1500 feet to cover the floor. If the stuff is 1¼-inch thick, add 25 per cent. to these figures; if 1½, add one-half to them. The second floor, having the same area as the first, will, of course, require the same number of feet to cover it—namely, 1500 feet. The attic, Fig 7, being constricted on account of lack of head room, will require special figuring. The dancing room is 16 x 35 feet, without the adjunct on the right, thus giving an area of 560 feet. The adjunct is 8 x 9 feet, and the area 72 feet. The bedroom and closet measure 10 x 12 feet, with an area of 120 feet. The storeroom, bathroom, hall and other places measure 18 x 20 feet, giving an area of 360 feet. We have, then, for the attic floor a total of 1112 feet, to which add the usual 10 per cent. and we have 1223 feet of stuff required.

For the verandas we have for the front, 8 x 34 feet; area, 272 feet. Left wing of front veranda, 8 x 10 feet, or an area of 80 feet. Side veranda by kitchen, 6 x 26 feet, or an area of 156 feet. Latticed porch, 6 x 13 feet, with an area of 78 feet. Porch in rear of dining room, 6 x 4 feet; area, 24 feet. Balcony floor in front, second story, 10 x 10 feet; area, 100 feet. Together these make a total of 770 feet, to which add 10 per cent. and we have 847 feet required for verandas and porches. Let us recapitulate:

	Feet.
Flooring for first story	1,500
Flooring for second story	1,500
Flooring for attic story	1,223
Verandas, porches, etc	847
Total flooring	5,070

This is within 30 feet of 51 squares, so for convenience sake we will say the building requires 51 squares of flooring. If the stuff is less than 3 inches wide—and if hard wood it should not be any wider, and if pine it should not be more than 4 inches wide—a man will lay about 3½ squares in a day. If pine, and 4 inches wide, he will put

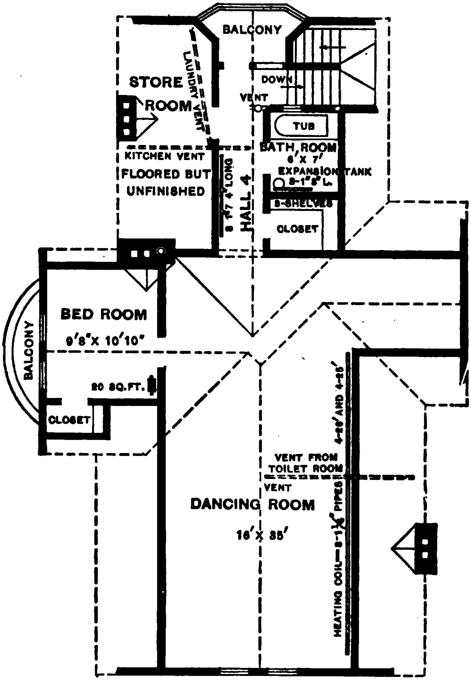

Fig. 7.—Attic Plan.—Scale, 1-16 *Inch to the Foot.*

down 4 squares a day. Here, then, we have the cost of labor in a nutshell. Fifty-one squares divided by 4 squares, one day's work for one man, will give the following result: 51 ÷ 4 = 12¾. That is, it will take one man 12¾ days to lay the 51 squares of flooring. Now, if we know how much per 1000 we are to pay for the flooring, all we have to do is to multiply the cost of 1000 five times and add the cost of the odd 100 feet, then add the cost of 12¾ days' labor, and the cost of nails, which in the case of flooring will be the cost of 1 pound of nails for each square of flooring, or 10 pounds per 1000 feet of flooring, face measure.

Basis of Calculation.

It must be understood that all the calculations made with regard to the floors are made on the basis of 1-inch stuff and for face measure. If heavier stuff is employed some extra allowance must be made for laying the floor, as it takes more cutting and is heavier to handle. The increase in price for every quarter inch in thickness is about 2½ per cent. That is, instead of laying down 4 squares per day, as with 1-inch stuff, the workman will only be able to lay down 3 9-10 squares if he uses 1¼-inch stuff, and so on for each quarter of an inch. For hard woods the percentage is very much greater, amounting fully to from 7½ to 10 per cent. difference. The estimator will note this fact. Certainly it is not much, but it is these small differences multiplied that measure the distance between profit and loss on a job of work of any magnitude.

Having the roof on, the floors all laid, the partitions up and the grounds in place, with all the necessary door and window frames set, it will be in order to lath and plaster the building throughout. As we have boarded up the gables, though not finished them, there is but little danger of either floors or the plastering being injured by the weather.

Plastering for Brick House.

We will next proceed to "figure up" the plastering and find out how many yards the building contains, including basement and attic.

In order to get the exact number of square yards of plastering there are in this house it will be necessary to commence in the basement and take each room by itself, measuring the walls and ceilings separately. By this method we will be able to arrive very closely to the exact figures. It is understood that all the brick and stone walls throughout the whole building are to be "rendered" or plastered one coat on their inner faces before the strapping and grounds are fastened in place. It will not be necessary, however, for us to make a special measurement of this "rendering," as the plasterer when tendering for the work by the yard makes his charge per yard enough to cover any extra expense the rendering will entail.

Commencing with the basement, we find the front or cellar part to be 8 feet 6 inches in the clear in hight, and taking the front wall as a starter we have 25 feet × 8 feet 6 inches = 212½ feet. This being divided by 9 feet will give the number of yards in the front wall, thus: 212 ÷ 9 = 23 5-9 yards. It will be noticed we have left out the fraction of a foot, as plasterers seldom count the smaller fraction either way. The left hand wall measures 22 feet × 8 feet 6 inches = 187 feet ÷ 9 = 20 7-9 yards. The opposite side, including the short "jog," contains the same number of yards—that is, 20 7-9. The rear end of the room, taking in the jog, measures the same area as the front wall—that is, 23 5-9 yards. Now we have the ceiling, which measures by average 22 × 20 feet = 440 ÷ 9 = 49 8-9 yards. We have, therefore, for plastering in front room of basement:

Front and rear walls	$47\,^{1}/_{9}$ yards.
Side Walls	$41\,^{5}/_{9}$ yards.
Ceiling	$49\,^{8}/_{9}$ yards.
Total for room	$138\,^{5}/_{9}$ yards.

The furnace room measures 16 x 16 feet and 8 feet 6 inches high. Each of the four walls will, therefore, measure 136 feet in area, or 136 × 4 = 544 ÷ 9 = 60 4-9 yards.

The ceiling, being 16 x 16 feet, measures	256 feet.
Which being divided by 9 gives	$26\,^{2}/_{9}$ yards.
We get then for this room:	
Walls	$60\,^{4}/_{9}$ yards.
Ceiling	$26\,^{2}/_{9}$ yards.
Total	$86\,^{6}/_{9}$ yards.

The fuel room measures on the ground 15 x 17 feet and 7 foot 6 inch ceiling. This gives 64 feet of wall 7 feet 6 inches high. Therefore, 64 feet × 7 feet 6 inches = 480 ÷ 9 = 53 6-9. For the ceiling of this room we have 15 × 17 feet = 225 feet, which, divided by 9, gives 28 3-9 yards, making for the fuel room:

Four walls	$53\,^{6}/_{9}$ yards.
Ceiling	$28\,^{3}/_{9}$ yards.
Total	82 yards.

For the laundry, closet, stairway and storage cellar we have 104 feet of wall, 7 feet 6 inches high, therefore 104 feet × 7 feet 6 inches $= 780 \div 9 = 86\ 6\text{-}9$ yards. The ceiling averages 20×16 feet $= 320 \div 9 = 35\ 5\text{-}9$ yards.

We have then:

Walls	$86\,^6/_9$ yards.
Ceiling	$35\,^5/_9$ yards.
Total for laundry	$122\,^2/_9$ yards.

This makes for basement altogether as follows:

Front room	$138\,^5/_9$ yards.
Furnace room	$86\,^6/_9$ yards.
Fuel room	82 yards.
Laundry	$122\,^2/_9$ yards.
Total for basement	$429\,^4/_9$ yards.

Or, in round figures, 430 yards of plastered work.

In this calculation we have made no allowance for openings, nor for well hole of cellar stairs; first, because the openings are small and troublesome, and because no extra allowance has been made for the circular wall under the sitting room window. With regard to the well hole of stairs, it must be remembered that the soffit, or under side of the stairs, will have to be lathed and plastered the same as a ceiling, and will, therefore, require as much lathing and plastering as would the ceiling, and in some cases considerably more. We might add here that wherever the chimney breasts project past the face of the wall on the inside, as they do in two instances in this plan, the portions projecting should not be strapped or furred, but the plastering should be put on the bricks or stone without any wood work intervening. The reason of this is obvious.

Plastering on Main Floor.

On the main floor we have a higher ceiling and more partitions, both sides of which are lathed and plastered, and the openings being larger and more numerous we will allow for one-half of them in our measurements. Commencing with the parlor and reception hall, we find we have 122 feet, 10 feet high, without counting openings; then $122 \times 10 = 1220 \div 9 = 135$ 5-9 less 11 yards—half the openings in those rooms. This gives for the walls 124 5-9 yards. The ceilings for these two rooms measure $25 \times 18 = 450 \div 9 = 50$ yards, making for:

Walls	124 yards.
Ceiling	50 yards.
Total	174 yards.

For the passage and closet we have 40 yards by actual measurement. In the sitting room we have 71 feet of wall by 10 feet, which gives $71 \times 10 = 711 \div 9 = 81$ yards. The ceiling is $15 \times 20 = 300 \div 9 = 33$ yards. There are eight openings in this room, which measure near about 22 yards, the half of which will make 11 yards, to be deducted from the foregoing as follows:

For passage and closet	40 yards.
Walls in sitting room	81 yards.
Ceiling in sitting room	33 yards.
Total	154 yards.
Less openings in sitting room	11 yards.
Yards to be charged	143 yards.

Now, take the dining room, which is marked 15 x 17 feet. This gives 64 feet of wall 10 feet high. Thus $64 \times 10 = 640 \div 9 = 71$ yards. The ceiling $15 \times 17 = 255 \div 9 = 28$ yards. From these figures we have:

For walls	71 yards.
For ceiling	28 yards.
Total	99 yards.
Less for openings	9 yards.
To be charged	90 yards.

We now have the kitchen, pantry, closets and stairways. In these we have, all told, 150 feet of wall 10 feet high—$150 \times 10 = 1500 \div 9 = 188$ yards. The ceilings of these rooms make 340 feet, or 38 yards nearly. These figures give us:

Walls	188 yards.
Ceilings	38 yards.
Total	226 yards.
Less for one-half of 20 openings	25 yards.
Leaving to be charged	201 yards.

Let us now recapitulate amount of plastering on main floor:

Parlor and reception hall	174 yards.
Sitting room, passage and closet	143 yards.
Dining room	90 yards.
Kitchen, pantry, closets, etc	201 yards.
Total for main floor	608 yards.

In measuring up for this floor we have paid no attention to fractional figures either way, as they were so small as not to be essential. In counting the openings, it must be understood that on all inside partitions they must be counted twice. It is usual to allow for single doors in partitions, 5 yards for both sides of the door, or 2½ yards for one side. This measurement is obtained as follows:

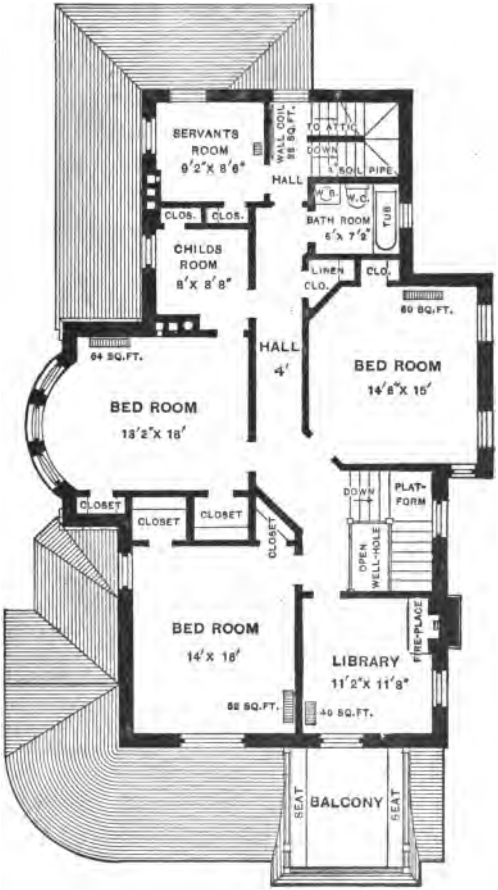

Fig. 8.—Second Floor.—Scale, 1-16 Inch to the Foot.

A door, including frame, will average 3 x 7 feet, which makes 21 feet surface, or 2⅓ yards. No allowance is made for casings or other finish, because the lath—and one coat at least of plaster—finishes up to the jambs, and the finish lays over. The rule also applies to windows, with some exceptions, of course, where the windows are larger than ordinary. Generally a medium sized window in a building should be adopted as a guide for estimating the openings for plastering.

Plastering on Chamber Floor.

In estimating for this and the attic floor we will simply give the number of yards in each room, without unfolding the methods by which they are arrived at, as we have given sufficient examples to enable the student to verify the figures presented. The walls on this floor are 9 feet 6 inches high—a fact which the estimator must note. Referring to Fig 8, first, take the

Front bedroom, 14 x 16 feet, No. of yards..................	76
Library, 11 x 12 feet, No. of yards..........................	40
Left bedroom, 13 x 18 feet, No. of yards....................	83
Right bedroom, 14 x 15 feet, No. of yards...................	78
Servant's room, child's room, bathroom, back stairway, and 4 closets..	176
Main stairway, hall and front closets........................	142
Total number of yards in chamber floor.................	595

It will be seen that there are only a few yards difference between the first and second floors. Half of the openings on the second floor have been deducted and the soffit of attic stairs provided for, and the figures obtained are as nearly correct at it is possible to get them from paper.

Plastering on Attic Floor.

In order to give a clear idea as to the method of getting the exact number of yards of plastering there are on this floor we will give the formulas as we proceed. Commencing with the dancing room, including the space in the right projection as we look at the plan (see Fig. 7), we have 91 feet of wall line. By referring to Fig. 1 it will be seen that this wall on the sides is only 5 feet 6 inches high, while the ceiling formed by the collar beams is 8 feet 6 inches high. Here are some conditions we have not met in the other parts of the house. How shall we deal with them? We have 91 feet of wall, then 91 feet × 5 feet 6 inches = 500 ÷ 9 = 55 yards, and a little over. Now, if we measure the distance up the rafter from the junction of the wall to the collar beam we find it to be 3 feet 6 inches, which, multiplied by 91 of wall, will be 91 × 3 feet 6 inches = 318 ÷ 9 = 35 yards in round figures.

It will be noticed that at the three ends of the wall the ceiling does not run up to the rafter, but is formed by the ceiling joists above. This, however, will make so little difference in the actual surface plastered that it is unusual to take note of it when estimating for this work, but it is thought well to make mention of it, or it might be thought the matter was overlooked. The difference would not be more than a yard or two, and this in favor of the contractor.

Now we have the flat ceiling to deal with, or that portion which hangs directly on to the collar beams. It will be seen by reference to Fig. 1 that the plumb line dropping down from the collar beam where it joins the rafter measures 2 feet 6 inches from the wall. This will make the flat ceiling 5 feet narrower than the floor, from the front of the building to the end of the right wall. This will make the ceiling 11 feet wide by 27 feet long; then $27 \times 11 = 271 \div 9 = 30$ yards. Then we get from the projection to the bedroom $25 \times 8 = 200 \div 9 = 22$ yards, therefore for this room we have:

Walls	**55 yards.**
Slope of rafter	**35 yards.**
Ceiling of nave	**30 yards.**
Projection, etc	**22 yards.**
Total	**142 yards.**
Less for openings	**3 yards.**
To be charged	**139 yards.**

In the bedroom we have 56 feet of wall with closet included. This wall is 6 feet high, therefore $56 \times 6 = 336 \div 9 = 37$ yards. For slope on rafter: 56×3 feet 6 inches $= 196 \div 9 = 22$ yards. For flat ceiling we have $9 \times 6 = 54 \div 9 = 6$ yards. This makes for bedroom and closet:

Walls	**37 yards.**
Slope	**22 yards.**
Ceiling	**6 yards.**
Total	**65 yards.**
Less for openings	**5 yards.**
Leaving to charge	**60 yards.**

In the passageway, bathroom, closets and stairway we find by actual measurement 110 feet of wall. This will average about 7 feet 6 inches high, one portion being higher, and another lower. Therefore 110×7 feet 6 inches $= 825 \div 9 = 91$ yards. The ceiling measures 19

$\times 10 = 190 \div 9 = 21$ yards. We get then for this section:

Walls	91 yards.
Ceiling	21 yards.
Total	112 yards.
Less for openings	14 yards.
Leaving to charge	98 yards.

Quantity of Plastering Required.

This ends the estimating for lathing and plastering. Let us recapitulate and see how many yards of plastering are in the whole building.

Front cellar	$138\,{}^{5}/_{9}$ yards.
Furnace room	$86\,{}^{6}/_{9}$ yards.
Fuel room	82 yards.
Laundry, etc.	$122\,{}^{2}/_{9}$ yards.
Parlor and reception hall	174 yards.
Sitting room, passage and closet	143 yards.
Dining room	90 yards.
Kitchen, pantry, stairway, etc.	201 yards.
Total for chamber floor	595 yards.
Dancing room in attic	139 yards.
Bedroom in attic	60 yards.
Passage, bathroom, etc., in attic	95 yards.
Making a grand total of	$1{,}926\,{}^{4}/_{9}$ yards.

This being obtained, we have but to multiply 1926 by the cost per yard in the locality where the building is to be erected, and add to the sum total such a percentage as will insure the contractor from loss. It is usual, when this work is taken by the general contractor, and is to be sublet, to add at least 10 per cent. to the sum total when bidding for the work, the 10 per cent., of course, to be retained by the general contractor to remunerate him for extra labor in making estimates and for assuming the responsibilities inherent in contracting. Ten per cent. is barely enough, but in these times of low prices and keen competition contractors are obliged to work on a very narrow margin in order to obtain work.

Cornices and Ornamental Plaster Work.

We have not made any estimate for molded stucco work, cornices, or plaster center pieces. This work, at any rate, is usually done by the foot, running measure, or by the piece, the cost being regulated by the elaborateness of the design, or by the width of cornice and number of its members.

In measuring cornice work the custom is to measure the wall from corner to corner, and where there are external angles the extreme limit of the molding on the ceiling is the measure of length. Thus a wall just 12 feet from corner to corner will require 12 feet of cornice; but suppose the wall measures 12 feet from a corner to an external angle, and the cornice projects on the ceiling 2 feet, then the plasterer's measure will be 14 feet, inasmuch as it will be necessary to project beyond the external angle on the ceiling, in order to give sufficient length to form an adequate return.

We have avoided prices both for plastering and stucco work, as these are governed by local requirements, and are now prepared to estimate on the finishings.

We have now obtained close figures on excavating, stone work, concrete, brick work, timber and rough lumber, rough covering and plastering. If there are to be stucco cornices or other ornamental plaster work, note must be taken of it and charged accordingly. Cornices are usually charged for by the foot, running measure, if not more than 15 inches girt. If more than 15 inches, or if paneled, they are measured on the profile of the moldings, and are charged by the foot superficial. For each internal angle 1 foot extra should be charged, and for external angles 2 feet or more, according to the girt of the cornice. If a cornice is elliptical or circular, as would be the case if one was put in the sitting room in the house under consideration, an extra price must be charged; in this instance about 50 per cent should be added to the straight rate. If the cornice is enriched by cast moldings, flowers or other complicated figures a corresponding charge should be added. Sometimes this may run as high as three or four times the cost of a plain cornice covering the same area, and much will depend on the design. Center pieces, brackets, angle beads and similar work must be charged for in accordance with their dimensions and design. It is impossible here to give any idea of what the prices of these should be without the designs and dimensions before us.

External Wood Finish.

Under this head may be considered windows and outside doors and frames, gablings, cornices, verandas, railings, balconies, lattices, steps and balustrades. Commencing with the front, as exhibited in Fig. 1, we find the front or entrance steps to average 10 feet in length, the treads covering 1 foot in width and having a rise of 7 inches. There are three treads and four risers, and as the treads are 2 inches thick they will measure 60 feet of lumber, which, added to four risers and the stuff required to make coves under the nosings of treads, will make about 100 feet of clear lumber. Then we have the strings to provide, two for outside and two bearing strings. These will require 30 feet of stuff, making a total of 130 feet of good lumber, together with 3 pounds of nails, and one and a half days' work for one man to make, set in place and finish; the stuff, of course, being run through the mill for him. From these figures the total cost of entrance steps may be readily obtained.

The porch steps and platform entering the dining room from the rear consist of three steps 6 feet long and 12 inches wide by 2 inches thick. These will require 18 feet of lumber, and four risers 6 inches wide will make 12 feet more, and the platform, 3 x 6 = 18 feet; strings, bearers, moldings and side casings will add another 54 feet to the lot, making a total of 102 feet. It will require about 4 pounds of nails to build the steps, and will take a man two days to build and place them.

Front Veranda.

We now come to the front veranda, with balcony over the front door. There are 14 posts below and 4 above, making a total of 18 square posts 6 x 6 inches by 10 feet = 30 × 18 = 540 feet. The cornice measures around the veranda about 56 feet, and the upper cornice or balcony about 33 feet, making a total of 89 feet of cornice, which is fairly correct. To make this cornice, including plate, frieze, soffit and fascia moldings, will require 2½ feet of stuff for every foot in length, which will make a total of stuff required for cornice of 243 feet. One hundred feet of stuff will be wanted for rails, and it will require 110 square balusters 1½ inches by 2 feet. These will measure 50 feet in the plank. Besides this there will be required about 12 feet of stuff for caps of balcony posts, rosettes, etc. This, then, makes a total for front veranda:

	Feet.
Posts	**540**
Cornice	**243**
Rails	**100**
Balusters	**50**
Caps, etc	**12**
Total	**945**

or in round numbers 1000 feet. This figure, of course, does not include roof boards, flooring or rafters, all these being estimated under rough lumber.

It will be noticed that a part of the side of balcony and spandril in end of veranda are shingled with picked and squared shingles. To do this will require nearly 1000 picked shingles, for which double price should be charged, both for material and for labor. If all this material is prepared at the mill, and made ready to put up, it will require ten days' work of one good man to finish it, and it will cost as much more to prepare and deliver the stuff on the ground, and to the cost of lumber, shingles and mill work must be added the cost of 30 pounds of nails of various sizes. With this data the estimator should experience no difficulty in arriving at reliable figures of the cost of the veranda ready to be painted.

Lattice Work Panels.

Under the veranda floor are five lattice work panels measuring 9 x 1½ feet. Usually this work is charged by the foot square, superficial, and in the locality where this is written 25 cents is the average. In this case, however, the circular corner requires so much more labor and stuff that we place the price per foot, superficial, all around, at 50 cents, which will include frame and setting. This price will also cover nails and such screws as may be necessary.

Rear Veranda.

On the back veranda there are two flights of steps, which will require 150 feet of lumber to make, 6 pounds of nails and one day's work. There are ten posts 6 x 6 inches by 10 feet, to veranda and latticed porch, making 360 feet of stuff, and 50 feet of cornice, which in this case will require 3 feet of stuff for each running foot, making 150 feet; 100 feet for rails, and the same for balusters, brackets and cuttings. These, without lattice work and frame, will make:

	Feet.
Steps and posts	360
Cornice	150
Rails	100
Balusters, etc	100
Total	710

We will say 800 feet, 25 pounds of nails and six days' work, not including mill work, which would make in this case about two days more. The portion of the porch latticed contains 168 feet, which if charged at the rate of 25 cents per foot will make $42 completed. This includes frames, nails, screws, cartage and fitting.

Circular Balustrade.

The balustrade over the circular window, which is reached from the attic floor, consists, as shown in the sectional view, Fig. 9, of a number of pieces, and on examination it will be seen that the balustrade with rail and lower cornice is a somewhat complicated piece of work. The stretchout of the curve measures 15 feet, and its vertical dimensions are 2 feet 11 inches, while the width of the rail is 8 inches. This will require very nearly 300 feet of stuff to build, as there will be a considerable waste in forming the segments for the top and bottom rails, circular moldings and cants. We are supposing that the moldings are worked from the solid to the proper curve, as they ought to be for this kind of finish, but if all the moldings are struck on the straight, and then kerfed, the labor will be one-half less than the estimate we are about to make, and the work will be in a great measure a sham, for kerfed work at best for finished work is a poor excuse for good work, and revenges itself on the owner in a short time by premature decay and distortion. The balusters are square and coped over the bottom rail and held in place with finish nails below and fit in a groove above with slats cut in between to hold them in position.

The curved decking to receive the shingling is composed of narrow strips sprung in and fastened on bracket blocks nailed at regular distances around the circular face. As the curve is not very quick, the shingles if made 5 inches wide will readily adjust themselves to the conditions. It will require fully 300 picked shingles to cover the curved deck, and as they must be the very best and of equal thickness, and equal width it will not be too much

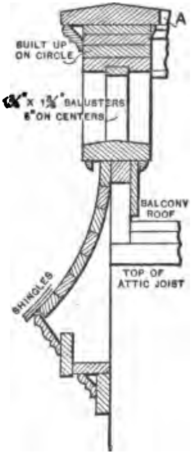

Fig. 9.—Details of Cornice and Balustrade of Circular Bay Window.—Scale, ¾ Inch to the Foot.

to count them as 500. Fifteen pounds of nails will be sufficient to complete the work, and it will require five days' work to build it and leave it all ready for the painter if all the material is prepared at the factory; and to prepare this stuff at the factory, working the moldings on the curves, will be equal to six days' work. If the curved moldings are kerfed the preparation will only equal three days' labor. This, of course, includes delivery at the works.

It will be noticed in Fig. 9, at A, that the moldings forming the profile of the top rail are continued along the wall of the building until they die in the projecting roof. This will make about 32 feet of molding and shingled frieze for which provision must be made. This will require 300 shingles and 100 feet of clean stuff for moldings, and one day's labor. From these figures the cost may be easily obtained where the cost of labor and prices of materials are known.

Gables.

There are four gables—one on each side of the house—and each one is covered with shingles, first being studded and tight boarded. In each one of these gables there is one or more openings, and in the rear gable over the kitchen there is a large opening leading on to a balcony. One gable contains 156 feet, a second one contains 88 feet, a third 132 feet and the fourth 80 feet, making a total of 456 feet. The openings measure 200 feet, which leaves 256 feet to be shingled with picked shingles. It will take at least 4000 shingles in the bunch to cover the 256 feet with picked shingles of equal width. Of course a part of the remainder may be used for other purposes. We have already made provision for the studding and rough boards required for these gables, so that here all we have to do is to figure on the shingling. As every workman knows, it is worth 50 per cent. more to lay shingles on a wall than on a roof, for reasons that are quite obvious, and where the shingles, as in this case, have to be made the right width, so that all the joints will line up uniformly, the labor and time required to make good work will be about double what it would be to lay shingles on a roof—a point worth knowing. In this case, then, we should charge up 3000 shingles at double the ordinary price of laying. If building paper is nailed on the boards before the shingles are put on the cost of putting on and price of labor must be added together with the cost of 12 pounds of nails for shingling. Over the openings are ribbon pieces about 8 inches wide, with molding planted on the face, these measuring nearly 40 feet in length. As they take the place of shingles we need not count them in the estimate, as the charge made for shingles will cover them.

Cornice Work.

Under the head of cornice we will include the whole of the work on and about the eaves, the barge boards on the gables and the paneled fascias connecting the gable barge boards. We find by actual measurement 116 feet of cornice, running measure. This cornice consists of eight members, besides the three members forming the bed for the gutter, as shown in Fig. 10. The whole of the 11 members measure 4½ feet in girt, so that we have 116 × 4½ = 522 feet of material in the cornice. To put this in place properly, all the stuff being ready to hand, would take six days' labor and about 20 pounds of nails. This includes the bed for the gutter. As all this is straight work, the preparation of the stuff and its delivery on the ground would equal two and a half days' work and give the mill men a fair profit on their labor and machines. In these estimates it must be understood that the cost of building scaffolds and moving them is included.

Barge Boards and Fascia.

The barge boards as exhibited in the elevations, Figs. 1 and 2, are simply plain board, 16 inches wide, with a small molding on it broken into panels of such lengths and widths as suit the length of the board. This is topped off with a cap molding, over which the edges of the shingles project. The horizontal fascia is similarly made, with the exception that the bed mold of the regular cornice is continued under it and the cap on top is heavier than that on the barge boards. Running up the gables is a soffit 16 inches wide, so that we have a girt line over barge board, moldings, bed mold and soffit of 36 inches, and as we have 148 feet of barge boards the stuff required to make it will be 148 × 3 = 444 feet. For the paneled fascia, of which we require 80 feet, the girt measuring 2 feet, the material wanted will be 160 feet, making a total required for barge boards and fascia of 604 feet. It will take four days' labor to put this in place, and five days to prepare the work ready to put in place, and fully 20 pounds of nails will be required to mold and fasten this work. If the barge boards and fascia are framed together, as they ought to be, and molded, the labor of preparing will be nearly doubled, but less nails will be required to do the work. If framed, the work will be put up in sections and fastened on properly prepared grounds with "feathers" grooved in all butt joints, but the caps and all running moldings will, where possible, be made the whole length of the board, or so arranged that their butt joints will break all joints in the barge boards.

We now come to the cornice on the main building, including the belt dividing the brick work from the shingling of the gables. Of the latter there is, by actual measurement, 81 feet in length, covering four gables. The belts are 18 inches wide, including band and bed moldings, and, as will be seen by examining Fig. 1, these beltings are paneled. As the kind of paneling is not specified we will assume that it is framed, with panels sunk and molded, and that the cap molding is formed of two pieces—namely, a beveled cap with wrought nosing, made to project

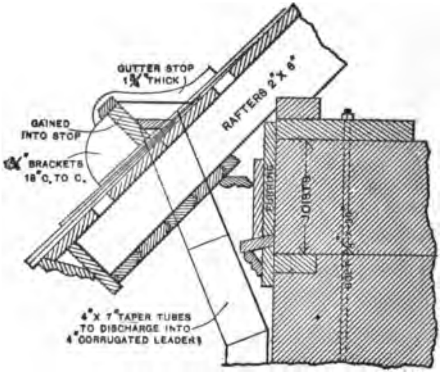

Fig. 10.—*Detail of Main Cornice.—Scale, ¾ Inch to the Foot.*

over the top rail 1 inch or more and having a cove or ogee molding under it as a sort of bed molding. Below the belting there is a cluster of members, forming a bed mold and finishing against the brick work. To make these belt courses, including all the moldings, will require about 3 feet of good material for each running foot, or, say, 300 feet of stuff. Preparing it in the factory, with the aid of machinery, will take 2½ days for one man. This includes framing, molding, cleaning and getting out stuff. To put it in place, erect scaffold and leave the work ready for the painter will take two men two days each, and will require to fasten and leave complete about 20 pounds of nails, including what may be required for building the scaffolding.

Main Cornice.

The details of the main cornice, drawn to a scale of ¾ inch to the foot, are shown in Fig. 10. The combination consists of furring, frieze, bed molding, sheeting, fascia and crown mold, the whole having a girt of 4 feet in round figures. The cornice, including the four gables and barge boards, measures 240 feet in length, which multiplied by 4 feet—the length of girt line—makes 960 feet of material (say 1000 feet) to make the main cornice and barge boards for the gables. To make this stuff in the factory, using machinery and completing it ready for putting in place, taking the stuff from the rough, will occupy two men three days each. This, of course, includes paneling and molding the eight barge boards. To put this 240 feet of cornice and barge boards in place will take two men four days each to complete the work. We say two men, because on a piece of work of this kind less than two men would be useless, and there would not be much gain by having a third man in the same gang for this kind of work, though an apprentice boy, to hold and handle stuff, pass nails, etc., makes a paying accompaniment.

Ridge Boards.

We have now about completed the outside of the building, with the exception of the ridge boards and the bracketing for the roof gutters. The ridge boards seem to consist of two pieces of 1-inch stuff 6 inches wide, nailed together so as to form the same angle as the roof. This is surmounted with a roll made from 3-inch stuff and having a V cut in it to suit the angle of the ridge. This is nailed on over the joint formed by the joining of the ridge boards. If a first-class job is desired, the V in the ridge pole should be well painted with white lead paint and oil before it is nailed in place. To make and put in place ridge boards and roll as described, and furnish all materials for same, where good working lumber costs on the average $25 per 1000 feet, will be worth from 5½ to 6 cents per running foot.

Windows, Doors and Frames.

In the basement there are 14 windows and frames, the windows consisting of a single sheet of glass each, 12 x 26 inches, and are built partly in the stone and partly in the brick work. The sash are hung at the top and fastened at the bottom with snap catches. The frames are made of sound 2-inch plank, having sill and subsill, and 2¼-inch blind stiles and cambered head outside. The cost of frame and sash, with interior trim, will average $2 or

$2.40, finished inside and out, and this without painting or glass. This includes fitting and hanging sash and furnishing bolts and other materials. These prices will vary, and are only given as a sort of starting point. In the basement are two doors, these being heavy panel doors with strong hinges, locks and heavy bolts. The jambs of these doors will be fully 17 inches wide, and should be framed and paneled. The cost of the doors will depend on their style and on the character of the hardware employed. Knowing the number of doors, the price of each, also of the frames and hardware, all the estimator has to do is to discover the cost of trimming the inside, the hanging and putting on of the furniture. This may be put down under ordinary circumstances at about half a day for each door, this including everything.

In the main story there are 13 windows, all of which are double hung box frames prepared for folding shutters and paneled splay jambs. They are, with the exception of one, all two-light sash, but they vary somewhat in size. Three of these windows have bent glass, with sash made to suit. The prices of these frames, ready to place in the wall, and the sash to go with them, can be obtained at any factory. In order to give the estimator an idea of what the cost of a frame suitable for the purpose may be when lumber averages $30 per 1000 feet and labor $5 per day, we may say that $4 would be a fair price. This would, of course, include sash, axle pulleys, molded sill and subsill and outside casings—plain, with hanging stiles plowed to receive inside finish. The circular frames and sash would cost double this amount. It must be remembered that this price is only an average one. In some localities it will be more; in others less.

There are five outside doors on this floor, the front entrance door having beveled glass in the upper part and a fanlight on top. The frame is simply paneled and has a molded transom. The frame, door and fanlight, delivered, will cost about $6.50. The other four doors will average about $5.10 each. These prices do not include hanging or finishing frame inside.

Setting Window Frames.

Up to the present we have made no reference to the "setting" of the frames. This is quite an item, and should not be lost sight of, as in a building containing a large number of windows and frames the "setting" would amount to quite a sum if time and material were considered. We have found that it costs about 25 cents to set a frame in the lower or main story, and 5 cents additional on each frame in the second story, and 5 cents more in third, and so on to the top. These figures are based on actual experience from five different operations.

In the second story there are 15 windows, all of them having the same width as those on the main floor, but they are somewhat shorter. The cost for each would be the same as for the lower story, with the exception of the French window or glass door over the front veranda. This will cost about $1 more.

In the attic are seven windows, four only of them being double and double hung. These four will cost $2.20 each. The three single ones may be put down at $1.50 each, complete. Altogether there are 49 windows in the building, 32 of which are supplied with double sash and are double hung. To fit and properly hang a pair of sash, adjusting weights, attaching hardware and properly balancing, will take a man from three to four hours' time, and occasionally, if things do not go right, a full half day will be used on one window the size of the ones in the building being estimated, so that the contractor can only be sure of his ground by charging a half day for each window. This, of course, includes fitting in stops, cording and leaving sash in good working order. To this cost must be added the price of cord, weights, lifts, pull downs and sash locks. These may be obtained from catalogues and price-lists. This completes all the estimates of costs for the walls, floors, partitions, roof, plastering, and all outside work, with the exception of the painting.

Inside Finish.

The Hall.

The plan of the main floors shows a reception hall with a paneled screen, newel, rail and balusters, projecting from the side wall 5 feet into the room. Against this, with the front toward the entrance door, is a seat, abutting the wall at one end and the newel at the other. Beyond this screen rise two steps and a platform, from which the main stairs spring, as shown in the detailed drawing, Fig. 12. The stair is of the dog-legged type, and turns square to the left, after a lift of eight risers from the first plat-

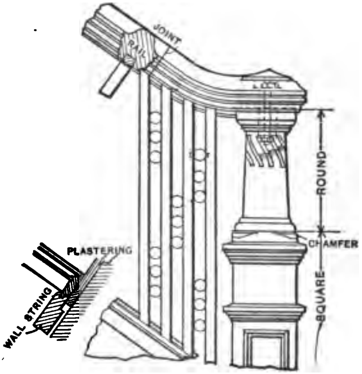

Fig. 11.—Detail of Main Stair Balustrade and Top of Newel Post.—Scale, ¾ Inch to the Foot.

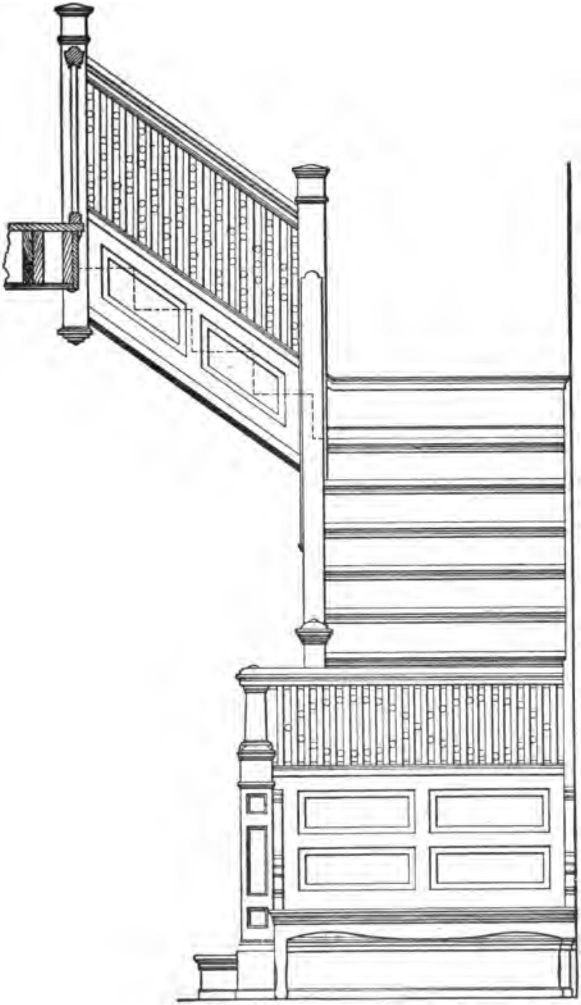

Fig. 12.—Elevation of Front Stairs Looking toward the Dining Room.—Scale, ⅜ Inch to the Foot.

form, the top flight having a lift of five risers. Altogether there are four newels, and the balusters are square with turned balls between them. The rail is straight and heavy, with a ramp running into the newel cap, as shown in Fig. 11. The strings are closed, paneled and molded, and the whole stairs are built of hard wood, cherry, birch or ash, and finished in hard finish. The lower newels are turned at the top, carved and molded, and are 5 inches square at the base.

Taking these stairs as a whole, with hard wood, suitable, costing $50 per 1000 feet and stairbuilders' labor costing $3.50 per day—for it is usual to engage a professional for this work, whose charges are high—the cost of the stairs will average about $4.50 per tread, including platforms, each of which counts the same as a tread. The seat, with ends and front and moldings, made in the same wood as the stairs, placed in position, will cost $3.50. We are presuming the hall to be wainscoted in hardwood paneling 4 feet high, in same style as paneling in the screen, panels molded, and the whole finished off with an appropriate cap molding. It may be broken into more panels if necessary without adding much to the cost, but as we are dealing with the plan before us, the cost must conform with it, and will be 65 cents a foot running measure. This means the cost of work and materials left in the wall ready for the finisher. The contractor under this estimate is entitled to half the doorways and the full length of paneling in spandril of stairs and no reduction for the lowering of the work to meet the window stools or other drops in the hight of the paneled work. The number of feet around the hall, less half the openings, multiplied by 65 cents will give the cost of wainscoting in the reception hall.

Sliding Doors.

There is one pair of sliding doors leading into the parlor, and an arch leading across the passage to dining room. The arch is finished in plaster and has a grille across the top, with pole for drapery. The cost of grille and pole will depend altogether on the style of the work, and the former may cost from 40 cents to $5 per foot. Catalogues and price-lists may be obtained from manufacturers. The opening leading into the parlor from the hall is closed with a pair of sliding doors, provided with the best door hangers and hardware furniture, the prices of which must be obtained from catalogues or otherwise. The doors are "built up" and veneered on both sides on a pine core, the veneering being in wood similar to finish in the rooms in which they show. A pair of sliding doors, 3 feet by 7 feet 6 inches, 1¾ inches thick, built up, and veneered on both sides, properly put together and well made, will cost $20. The hangers and other furniture should be of the best, and will cost $10. The extra material required for lining, frame, casings and moldings will cost at least $3. Then, for labor, there will be:

Lining up partitions and adjusting track	$10.00
Setting jambs and casing frame	5.50
Hanging doors and adjusting same	5.00
Putting in lock and shields	2.00
Cutting in stops, molding frame, etc	2.50
Total for labor	$25.00

This will make the doors, complete, cost as follows:

Doors	$22.00
Hangers and other furniture	12.00
Extra materials	4.00
Labor hanging doors, etc	25.00
Total cost of pair first-class sliding doors	$63.00

In this estimate we have supposed everything to be the best of its kind and to be in keeping with the character and style of the house, and we know from experience that the figures given are not a whit too high. To make, finish and trim a pair of sliding doors, furnish all materials of every description, such as would be required for this style of a house, and do all the work properly and in a substantial manner, will cost in every case from $50 to $70 if the contractor does justice to himself and the owner.

In the original design it was not intended to place doors in these large openings, but for many reasons we thought it better to make provision for doors between the hall and parlor. We will, however, omit putting doors in the openings connecting parlor with sitting room and sitting room with dining room, as we now know what the cost of sliding doors would be if placed in these openings.

The window in the hall looking out to the veranda is, like the inside of the front door, finished in the same style and with the same kind of material as the finish on the sliding doors. To hang, trim and finish front door, putting on hard wood casings inside, the cost will be, exclusive of material, locks, hinges, etc., $4.50. The hard wood casings, moldings and turned ornaments will cost $2, thus making the hanging, trimming and completing the front door, exclusive of cost of door and furniture, $6. The cost of the furniture will depend altogether on style and quality.

Hard Wood Window Trim.

As we have already estimated on the sash, window frames, hanging and fitting, we have only now to consider the cost of properly trimming the inside, and this one window will be the gauge for all the other hard wood finished windows in the house, excepting the circular ones in the sitting room.

Each window takes two upright architraves or casings, 7 feet long and 6 inches wide, and a head piece 5 feet long and the same width. This, with cap and fascia required,

Will cost, finished	$1.60
Stuff for stool, splay jambs paneled, etc	3.50
Egg and angle molding on fascia	.70
Putting in splay paneled jambs	1.50
Casing and molding	1.50
Setting in stool and cove	.60
To 15 feet super. inside blinds, at 20c	3.00
Hanging blinds and furnishing back flaps	1.50
Total cost of finishing inside of window	$13.90

It will now be in order to find out the cost of finishing the inside of the circular windows in the sitting room. The room being finished in hard wood, the sash must be made of the same material, or else veneered on the inside with it. In either case the sash—having bent or curved rails—will cost a little over double the amount they would if made with straight rails. If made in pine and with straight rails, the cost would average 96 cents a pair; if of hard wood and straight the average would be $2 a pair for oak, walnut or cherry, and $1.60 for birch, sycamore or maple. For bent rails in either of these woods the average would be doubled. The cost of trimming these windows and preparing heads, stools and other necessary circular or curved work will take double the labor of an ordinary window. From this the cost may be readily estimated, but we would in every case advise the contractor to get prices from the factory of such stuff as he may require, before making up his tender for the work, but where this cannot be done the figures given herewith will be found to be very nearly right and a tender based on them will insure the contractor from loss if he possesses ordinary common sense and ability.

Second Floor Finish.

It is understood that the second floor is finished in soft wood and painted. The cost of the windows on this floor has already been given, and the cost of trimming will be the same as that mentioned for price in the previous paragraph. There are 16 doors and doorways on this floor, all doors being four-paneled, molded and 1⅜ inches thick The casings throughout, windows and all on this floor are to be as shown in Fig. 13. The cost in labor to finish one of these doors, all the material being furnished and finished ready to put in place, will be about as follows:

Making frame	$1.00
Setting frame in place	.40
Casing frame, two sides	.70
Plauting back molding, two sides	.40
Fitting and hanging door	.50
Putting on lock and furniture	.50
Total	$3.50

There must be added to this the cost of material for frame, casings, moldings and the door itself. Each door will require 38 feet in length of 6-inch casing, and the same number of feet of band molding, also about 15 feet of dressed and rebated plank for the frame. The cost of this material will of course be governed by local prices, but about $1.50 will be the average cost of this material, as prices now range. Each door will probably cost another $1.50. This will make the cost of each door when completed ready for the painter, less the cost of locks, bolts and hinges, as follows:

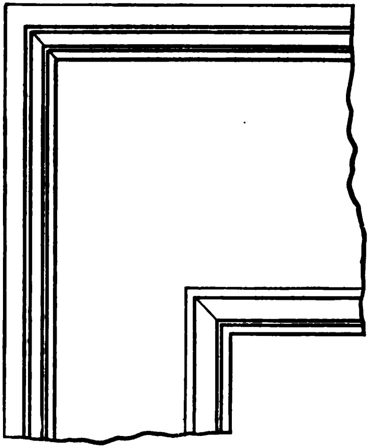

Fig. 18.—Detail of Head Casing for All Pine Finish.—Scale, 8 Inches to the Foot.

Cost of material for frame	$1.70
Cost of door	1.60
Making, setting frame and finishing door	3.00
Total	$6.30
If we add to this for lock and butts	1.00
We have the estimating price of	$7.30

Or, in round figures, $7.50 for each door, which is a fair price for an average door completed.

Base Boards.

It is not necessary that we should measure up the plans and give the exact number of feet, running measure, of base board required; suffice it to give the cost of laying down 100 feet of such as would likely be used in a building similar to the one under consideration. The dining room, kitchen and bathroom are wainscoted, the former in hard wood paneling, the latter in matched pine. The main hall, like the dining room, is paneled, which leaves the sitting room and parlor to be finished with a hard wood base, which should not be less than 14 inches wide. It should be a double base—that is, it should have one plain plinth board 8 inches wide with groove on top edge, and a molded top piece with tongue in lower edge to fit in groove provided in plinth. The top piece should not be less than 6½ inches wide, including tongue. To lay this base properly, coping internal angles and mitering external ones, is worth 5 cents a foot running measure, and twice that amount fitting around the curved wall in the sitting room. The material, finished ready to lay down, will cost from $40 to $75 per 1000, according to the kind of material used. When down, it is usual to plant a quarter round against it, the quarter round being nailed to the floor. This piece sometimes gets the name of "carpet strip."

The base on the second floor and in the attic is of pine or other soft wood and should not be less than 12 inches wide on second floor, nor 10 inches on attic floor. To lay either of these, including quarter round, is worth 3 cents per foot and the material is worth about 4 cents, making the total cost of base when laid about 7 cents per foot.

Back Stairs.

The back stairs leading from the kitchen to second floor are closed stairs, with a platform landing about half way up. These stairs will require 16 treads; each tread and riser, including strings, carriage and platforms, costing about $1.80. The stairs leading from second story to attic floor are similar to the above, with the exception that the platform is divided into three winders in order to get sufficient lift to reach the attic floor at a given point. The material used in this upper flight need not be so costly as that in the lower flight, which may bring the cost down to $1.50 per step. Back stairs in buildings of this kind are generally estimated to cost from $25 to $35. the former figure being the most employed. The estimate above is as near the current figures as it is possible to get them.

Wainscot.

An estimate for the hardwood wainscoting in dining room and main hall, to be finished as shown in Fig. 14, has been rendered, so we will not repeat, but that exhibited in Fig. 15, which is designed for the kitchen and bathroom, has not yet been figured. This wainscot may be of pine or of other soft wood in the kitchen, and worth about $1 per square of 100 feet to put in place, including cap and floor piece as shown. It is advisable that all bathrooms be finished throughout with hard wood, including wainscot. This would be worth $1.75 per square to put up, if of the same pattern as shown in Fig. 15. If paneled it would be much more. If done in pine same as kitchen it will cost the same as kitchen per square. Material suitable for this work will vary in price. In some places it may be obtained for $25 per 1000, matched and beaded;

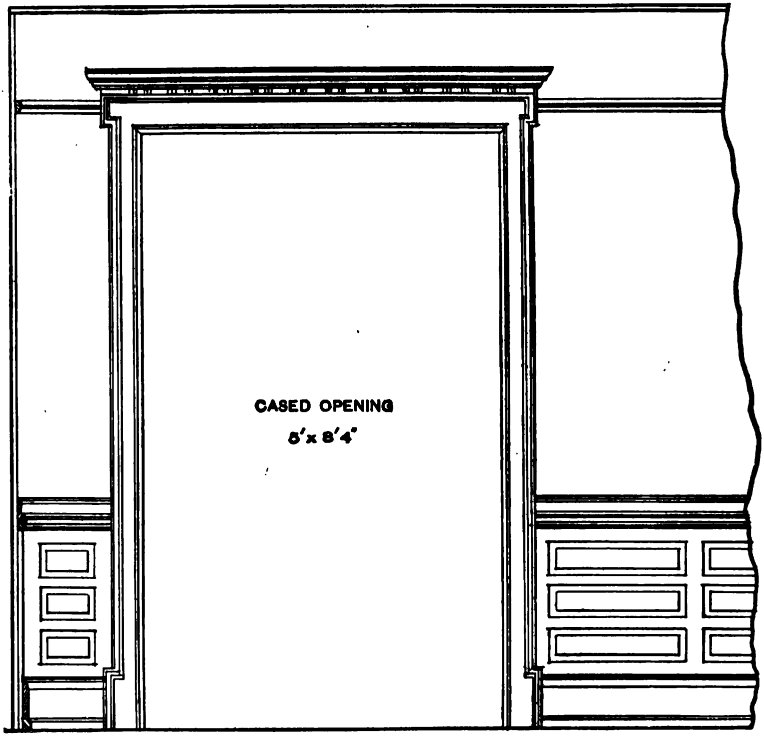

Fig. 14.—Elevation Showing Dining Room Finish.—Scale, ⅜ Inch to the Foot.

in other places it will run as high as $70 per 1000, so the estimator must first satisfy himself as to the price of the material before he figures out his tender for presentation. To the above must be added nails, which will average about 10 pounds to the 1000 feet of wainscoting Cost of nails must also be added to prices given for laying base.

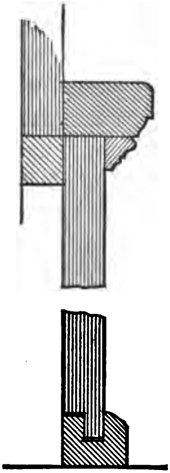

Fig. 15.—Detail of Wainscoting in Kitchen and Bathroom.—
Scale, 8 Inches to the Foot.

Closets.

There are nine closets in the building, not counting toilet closets, china and pantry closets. These nine closets are to be fitted up with two deep drawers, closed cupboard under drawers, with shelves and wide shelf over drawers, wardrobe hooks and ribbon pieces for hooks and upper shelves. To make drawers, doors, shelving and ribbon pieces will take about 100 feet of stuff for each closet, and the work, including fitting and hanging doors, making and dovetailing drawers and fitting them in place, building in frame and doing other work to complete the closet, will take about three days' work for one man. This of course includes machine work, putting on wardrobe hooks and trimming cupboard doors and putting hardware on drawers. Hinges, catches, drawer pulls, 1 dozen wardrobe hooks, nails and screws, may be purchased for about $1.30. Here, then, we have the estimate of one closet complete, ready for the painter, namely:

100 feet of stuff	**$....**
3 days' labor at	**....**
Hardware complete	**1.30**

This will be the average cost for each closet, and if multiplied by nine will give the total for all the clothes closets in the house. The toilet closet under the main stairs will be fitted up in hard wood and will have basin and marble slab and be plumbed for hot and cold water supply and waste, with hard wood doors under stand. Hard wood paneled wainscot and mirror frame, 1 dozen bronze wardrobe hooks on suitable ribbon pieces, the whole finish to conform with that in reception hall. The work alone to fit up this closet, exclusive of plumbers' work, will require one man about eight days. This includes all machine and other work. About 100 feet of good hard wood stock will be required, and the hardware, not counting mirror, will cost about $3, as all the furniture will be bronze.

The china closet leading off from dining room should have a glass door in front and be fitted up with hard wood inside and be supplied with drawers, shelves and hooks for cups and similar porcelain under shelves. From these figures the total cost of fitting up china closet in good style may be estimated. Besides wardrobe hooks and ribbon pieces in clothes closets, there will be required about 100 feet of ribbon pieces and 6 dozen hooks in kitchen, servant's room and attic, the total cost of which will be about $4 all told.

Bathrooms.

There are two bathrooms in the house, one for the family on the second floor and one for the servants in the attic. The main bathroom is supplied with wash basin, water closet and 14-ounce planished copper bathtub. This room is fitted up in hard wood in good style, wainscoted, as stated before, with matched and beaded narrow stuff. The front of tub is faced with same stuff, with roll top, the whole finished off nicely. The washstand has hard wood paneled doors, hung and trimmed with bronze trimmings. The water closet is detached, fitted with roll seat and cover hung with bronze hinges.

The cost of the wood work in this room, exclusive of wainscot, doors, windows and their trimmings, would be about $20. This would include labor, material and hardware, but would not include plumbing supplies. Since this house was designed, in 1894, it has become more usual to have bathtubs isolated or "detached," and this does away with the necessity of inclosing the bathtub with paneling or wainscot—a very important matter and one in the interest of cleanliness and health.

Where expense does not stand in the way, it is always better to have a porcelain tub and have the whole bathroom fitted up with open plumbing.

The bathroom in the attic should also have a wash basin and water closet, as well as a bathtub. The work may be plain, but all the material used should be of hard wood with japanned hardware. To fit up this room in keeping with finish in other parts of attic, including everything but plumbers' supplies, will cost about $16. This does not include windows, doors, wainscot or their trimmings.

The Kitchen.

The kitchen is fitted up with all modern appliances, and has, besides a range, a 52-gallon copper boiler, sink, splashboard, drawers, and other appurtenances. Fig. 16 shows the manner in which the sink is fitted up and gives sizes and full dimensions of work. Off the kitchen, on one side, is a pantry of good dimensions and which I will deal with separately, and to the right of the sink is the culinary closet. This closet is fitted up with drawers, racks, shelves and pastry mixing board. There are four drawers for flour, meal, sugar, etc., and a spice case made either with a nest of drawers or with tin cases incased

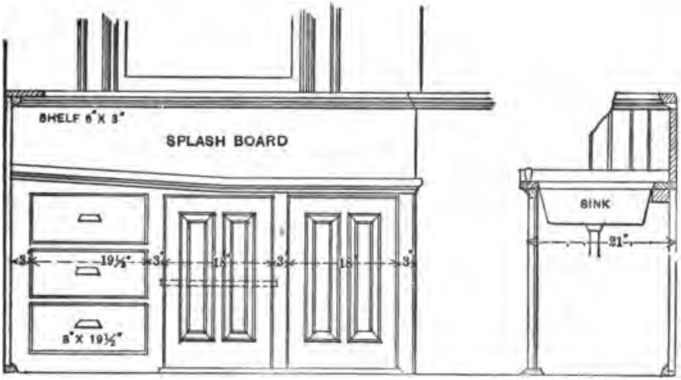

Fig. 16.—Elevation and Section of Kitchen Sink—Scale. ⅜ Inch to the Foot.

with wood, set in between the shelves. There will be required about 200 feet of stuff and six days' labor to fit up this closet. The necessary hardware, nails, tinware, screws, etc., will cost about $3. As the kitchen is wainscoted, it will be necessary to wainscot this closet, and we would suggest that it be done in hemlock, as hemlock is the most difficult of wood for mice or rats to gnaw through, owing to its splintery nature. The cost of wainscoting is not included in the above estimate. The sink complete will require about 40 feet of stuff to make it, and to prepare the stuff, make and fit the drawers, make and hang the doors, build in frame, put up splashboard, shelf and top, will take one man about two and a half days. The hardware, including drawer pulls, hinges, snaps, nails and screws, would cost about $1. We do not include the sink, as that is generally furnished by the plumber. Besides this work there will always be more or less shelving and hook racks required in a kitchen, and we have always made provision for at least $5 worth of extra work, usually found necessary before the room is in a proper condition to please the cook. This extra work will consist of corner shelves, pot hooks in various places, racks for dishes over sink, divisions in drawers and many other things not much in themselves, but which are inportant to the ruler of the kitchen, and which are time and material consumers; therefore, after every possible, and I might say impossible, thing has been provided for in a kitchen, it is always well to add in another $5 to please the cook, and it pays all round.

Pantry.

We now take up the pantry, which measures on the floor 7 x 7 feet, exclusive of china closet and cubby attached. On the rear end is a cupboard extending across the whole length, as may be seen in Fig 17. This cupboard, including doors, drawers and finish, is 8 feet 6 inches high, finished with molded cornice on top. The

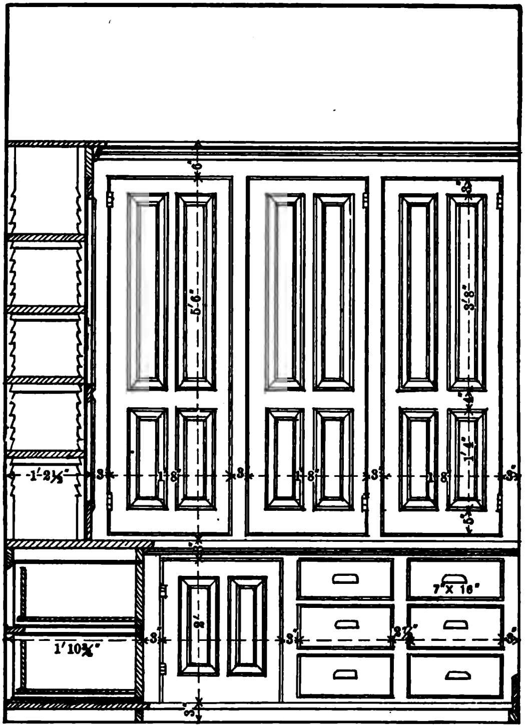

Fig. 17.—Elevation in Pantry, Looking Toward the Dining Room.—Scale, ⅜ Inch to the Foot.

dimensions of doors, drawers, divisions, stiles, etc., are all shown in the drawings by figures in feet and inches. The work is supposed to be done in pine, and if so, we would suggest that it be not painted, but simply varnished with white shellac—varnishing in three coats. If the material used is nice clear stuff, and the varnishing is neatly done, the pantry will be a paragon of neatness and healthfulness. Paint of any kind should never be used in a pantry if sweetness and purity are sought.

No backing other than the plastered wall will be required, so that we need not count for such in the cost. In measuring up we find this cupboard will require close on to 300 feet of good stuff for doors, drawers, shelving and moldings, and it will take one man six days to make and fit them, set up the work, fit on hardware and have all complete ready for the varnisher. To this must be added the cost of four pounds of nails, four pairs of butts and screws, four closet snaps, drawer pulls and molding brads. From these figures the cost may readily be obtained as follows:

300 feet stuff at $30 per 1,000	$9.00
6 days' work at $3	18.00
4 pounds of nails at 5 cents	.20
4 pairs of hinges at 8 cents (brass)	.32
4 closet spring snaps at 12 cents	.48
Drawer pulls (bronze)	.60
Brads, screws, etc	.20
Total	$28.80

This is a reasonable estimate for the work.

The side of pantry against the outer wall is finished with drawers, screen door and shelves, and splashboard under window, as shown in Fig. 18. To complete this part of the pantry will require about 125 feet of clean white pine, one pair of hinges, three drawer pulls, 5 feet wire screen,

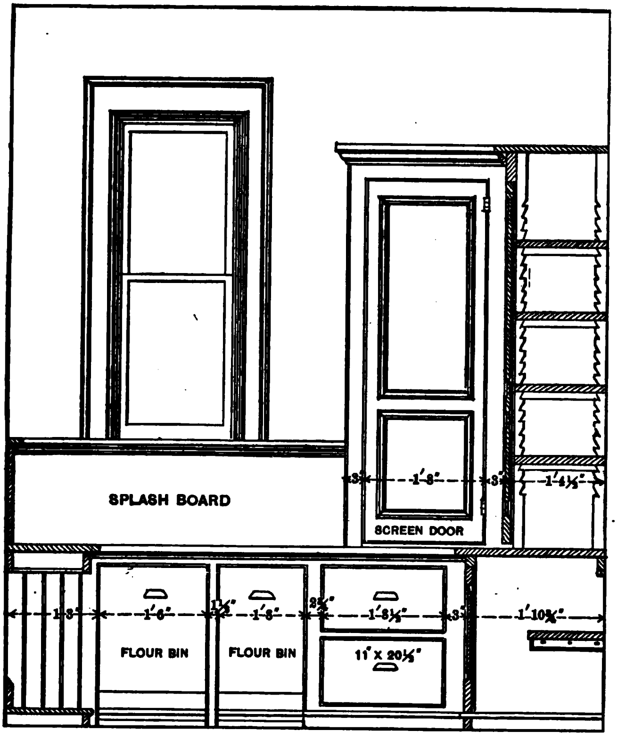

Fig. 18.—Elevation in Pantry, Looking Toward the Window—Scale, ⅜ Inch to the Foot.

three pounds of nails, screws, brads, etc., and cupboard snap. To complete the work will require about two and one-half days' work for one man. This will make the cost of this side of the pantry foot up as follows:

125 feet of clear pine at $30 per 1,000	$3.75
1 pair of hinges	.08
3 pounds of nails	.15
Wire screen	.50
Brads, screws, pulls and snap	.42
Two and one-half days' work at $3	7.50
Total	$12.40

There are shelves placed in the cubby, an opening and drop door into china closet with necessary trimmings and finish. These are not shown in the details, but as they must be provided to make the work complete we estimate that to provide the stuff and do the work in the same style as that shown will require $5. We have, then, for the total cost of fitments in the pantry, exclusive of door and window finishings, the following figures:

For cupboard	$28.80
For bins and wall fittings	12.40
Extras on cubby, etc	5.00
Total	$46.20

The Conservatory.

We have now to consider the conservatory, which measures on the plan 6 x 9 feet, with two projecting angles, 2 feet each, cut off. The hight averages 9 feet. It is closed in on one side, one end and the angles with glass, the roof being finished the same as the veranda. We have already given the cost of the floor, roof and foundation; the brick wall of the house forms one side and one end of this addition, the remainder being of glass. As will be seen by the section shown in Fig. 19, a solid wall of wood is built on the outside of the conservatory, running up above the floor about 2 feet, the top forming a regular window sill on which the sash rest. This leaves 6 feet 2 inches of sash in hight by 16 feet, less, of course, the five mullions. This would make nearly 100 feet of sash superficial, which, fitted in place ready to receive glass, would be worth 10 cents per foot, or $10 in bulk. Fitting up the low wall, paneling same inside and out, including material, making sash, sills and placing them, working mullions and fitting them in place and putting cornice and eave trough in place, as well as furnishing same, would cost as follows:

Dwarf wall and paneling, 16 feet at 20 cents.............	$3.20
Sash sill, moldings, stool and apron, 16 feet at 10 cents....	1.60
Cornice, fascia and eave trough, 16 feet at 30 cents........	4.80
Mullions in place..	4.00
Nails, etc...	.40
Total..	$14.00

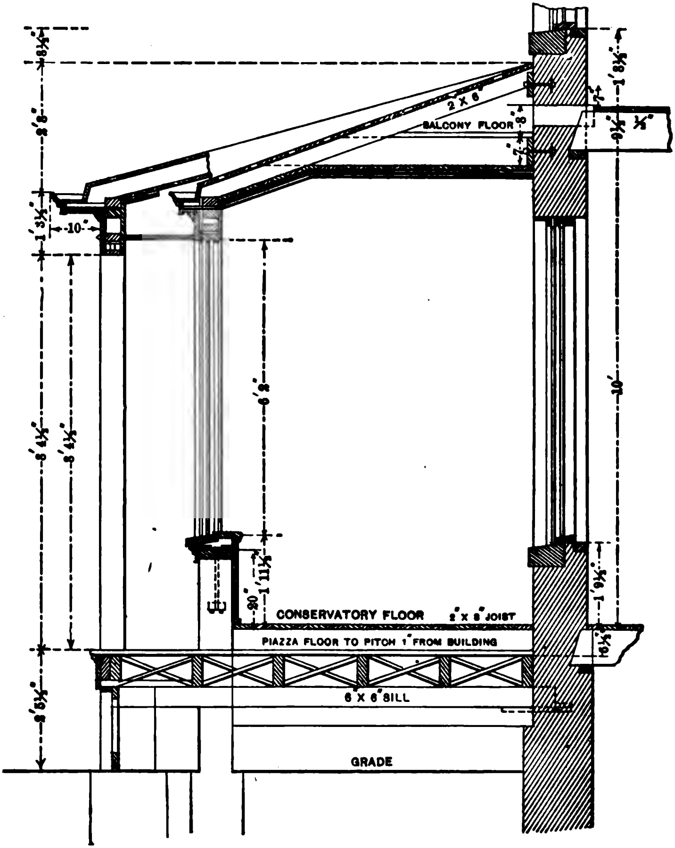

Fig. 19.—*Section through Conservatory and Front Porch.—Scale, ¼ Inch to the Foot.*

Adding cost of sash as above, $10, we have a total for the cost of the conservatory exclusive of floor, roof and foundation, which was previously given, of $24.

We have now completed all we undertook to do in the way of estimating, with regard to the brick house. It must be understood that we have not made any attempt to estimate on painting, glazing, polishing, plumbing, heating or electric work, only in so far as these trades required the assistance of the carpenter, and for any work he would likely be called upon to do under his own contract we have made reasonable allowance.

In all cases when prices of materials are given they have been based on those current in the nighborhood where these estimates have been prepared and have not been given with a view to having them quoted by the estimator when making up his tender, but merely as an illustration of the manner in which he may arrive at approximately correct results.

We have gone over this building very carefully, item by item, and the intending estimator will see that the results have cost considerable labor, but not more than an estimate on any similar building would entail if the estimator had an earnest desire to obtain figures upon which he could rely. We might also state that we have found in an experience of many years that in ordinary dwellings, costing from $2,000 to $15,000, the average time required to estimate will run from two hours for each $1000 for the first $3000 down to 30 minutes per $1,000 for the more costly buildings. In other words, a building costing, say, $12,000 will require fully 12 hours' time to take out all the quantities and estimate all labor and materials required to complete the structure, and then the estimator must be fairly quick at figures and have his schedule of prices for hardware, glass and all other materials and labor ready at hand.

One of the great troubles with young and inexperienced estimators is that they will take home a set of plans and specifications, read over the latter hurriedly once, perhaps twice, take hasty measurements from the plans, also hurriedly count windows, doors and other openings, then figure for an hour or two and make up their tenders. If they get the work they sign the contract and then commence to study the specifications more closely in order to get at their exact meaning. Probably they then discover to their disadvantage that they call for more than they figured on in their tender. Even the drawings show some things that have been overlooked, so that at the very outset of the work the young contractor is handicapped. All this goes to prove that no one can be a successful contractor without he is careful at his figures, but it does not follow that all careful figurers make successful contractors. Without the care, however, the second is impossible

Suggestions in Estimating Brickwork.

As I have stated in a previous chapter, bricks vary in size, each great center setting the pace, as it were, for all the towns and villages around it, Boston setting the standard for the New England States, which make the bricks 7¾ x 3¾ x 2¼ inches. In the Central States the bricks average about 8¼ x 4 x 2¼ inches, while in the Western States and some parts of Canada the standard sizes are 8½ x 4⅛ x 2½ inches, and this size will make the walls measure in thickness about 9, 13, 18 and 22 inches for 1, 1½, 2 and 2½ bricks in thickness. It is important, then, that the estimator should know the sizes of the bricks to be used in the works estimated upon before closing his estimate, for, as before stated, the size of the bricks used may have quite a bearing on the cost of brick work.

As a rule there is no difference in price per M. between the larger and smaller, or in the laying of same, for a bricklayer will lay in a wall as many of the large as he would of the smaller bricks in a day. Bricks taken from the same kiln often vary in size, as those that are made hard by the greater action of fire shrink more than those that are not subjected to intense heat; but, of course, the harder the brick the better it is. The shrinkage in some cases will amount to ¼-inch in the length of a brick, and this shrinkage should be provided for in the bulk estimate.

Pressed bricks are more uniform in size than common ones, and their measurement is usually 8⅜ x 4⅛ x 2⅜ inches. The laying of pressed bricks is much more costly than the laying of common ones, and I have found that to properly lay pressed bricks and furnish colored mortar for same the cost of laying averages 1 cent for each brick, or $10 per 1000. This, however, does not include cut or gauged work, or the laying of ornamental terra cotta bricks, or belting courses or panels; only plain face work with cut or beaded joints. There is a tile brick (pressed) in the market called Roman brick, that measures 12 x 4 x 1½ inches. This style of brick is also termed Carthagenian, antique and tile brick, according to its color or other qualities. These bricks are used for ornamental work, and sometimes for building altogether. They make a very handsome wall if properly handled. They cost more than ordinary pressed bricks, and it costs from 10 to 25 per cent. more to lay them per thousand.

All the calculations made for cost of labor in this work are based on a nine-hour day's work. When the conditions are different allowance must be made, either by adding to the cost if the eight-hour system is in vogue, or deducting if the ten-hour system prevails. This will be a matter of simple calculation.

Quantities of Bricks and Mortar.

It is a matter of some difference of opinion as to the exact amount of mortar required to lay a given quantity of brick work. It may be assumed, however, that where bricks are 8¼ x 4 x 2¼ inches, a cubic yard of brick work laid with ½-inch joints will require from 0.35 to 0.40 cubic yard; if the joints are ¼ to ⅜ inch thick, a cubic yard of brick work will require from 0.25 to 0.30 cubic yards of mortar; or 1000 bricks will require from 4 to 5 cubic feet of mortar. If the joints are ⅛ inch thick, as for pressed brick work, 1000 bricks will require from 1½ to 2½ cubic feet of mortar. This being known, it should not be difficult to tell exactly the cost of material required to build up 1000 bricks in a wall, having cost of bricks, sand and lime at hand, including hauling. To get at it a little quicker, perhaps, and also to furnish data for estimating the laying of bricks, with different grades of cement, the following is submitted: To lay 1000 bricks, 1 barrel of lime and 3 barrels of sharp sand will be required. If mortar is to be colored, add about ½ peck of "mineral" color, mix color in lime before mixing in sand. Prepared colors are always the best to use.

To lay 1000 bricks in cement will require 1¾ barrels of cement and 2½ barrels of sand; or, for a stronger wall, 2 barrels of cement and 2½ barrels of sand. Colors mixed in cement mortar had better be mixed in dry, or if moist colors are used they should be mixed with the water used in mixing the cement. These quantities are made out for mortar joints not more than ¼ inch thick; and I may add they are, after all, only approximate, as in the hands of some workmen they would be too large, while in others they would be too small; but they are a good average, and may be relied upon as being nearly correct.

Where bricks are to be laid on a circular base, such as a round tower, oriel or circular bay, the cost of laying will increase from 15 to 30 per cent., according to the diameter of the work; the smaller the diameter the greater the cost per thousand. projecting cornices, panels, ornamental belt courses, corbels or similar work will cost from 20 to 50 per cent. more per thousand to lay than ordinary brick work.

Enameled bricks are worth from 1½ to 2½ cents each to lay in the wall and properly gauge joints and face. Ornamental work with enameled or glazed bricks must be valued according to the design to which they have to be laid, and it is not the purpose of this little work to describe the methods and rules for estimating the cost of laying enameled bricks to design, terra cotta ornamentation or carved brick work. These may safely be left for future consideration.

It is somewhat difficult to tell exactly how many bricks a man will lay in a day of nine hours, as conditions vary, and some workmen are much more expert than others in handling the bricks and taking up and spreading the mortar; but if well supplied with materials, and scaffolding properly adjusted ready to his hand, and a long wall to work at, and the bond ordinary, a good man will lay from 1400 to 1600 bricks, by making an extra effort. This will be at the rate of over three bricks a minute if the larger number of bricks are laid, and about two and five-eighths bricks per minute for the smaller number. To lay so many bricks a day, as is readily seen, a man must "hustle" from the time he commences work until the last minute of the day arrives, a task that usually uses a man up in a short time and renders him unfit for much service the next day. In an experience extending over

40 years I have found that the average bricklayer will not lay down in ordinary work more than two bricks per minute, or 120 bricks per hour, and to do this, even, everything must be favorable. If, however, there are many openings to finish around, or any extra facings in the wall, 100 bricks an hour will be pretty good speed. When a good finished street front is required, and the joints are to be regular and evenly struck, one brick a minute, or 60 per hour, may be considered fairly speedy work; but should there be numerous openings, belting courses, cornices and angles, then from 30 to 45 bricks an hour may be taken as good speed, according to the number of angles, belt courses, etc.

When walls are of great length. and rough work only is required, such as is generally employed on factories, warehouses, barns and similar buildings, a man may lay from 1400 to 1500 bricks in a day of nine hours, providing everything is handy for him, but this will be rather the exception than the rule, and an estimate based on the smaller figure will be nearer the correct result than if the larger figure is employed.

Where three bricklayers are employed, one good laboring man will supply them with bricks and mortar, if these materials are not more than 20 or 25 feet from the building and he does not have to climb a ladder or mount a scaffold. When mortar has to be mixed and water carried an extra laborer will be necessary for every four bricklayers, besides the laborer who "tends" the three bricklayers, as stated before; and to this must be added another laborer for each story after the first one. This, then, would arrange itself thus: First story, three bricklayers and one laborer; second story, three bricklayers and two laborers; third story, three bricklayers and three laborers, etc. Then add the mortar mixer, etc., for each four bricklayers. In all cases the lime must have been slaked and in a putty state. To slake lime and run it off and have it made ready for the laborer to make into mortar is a matter of cost, like getting the proper quantity of sand, and the amount will depend altogether on the quantity made.

The higher the building the greater cost per thousand bricks laying in the wall, apart from extra for laboring men. This increase of cost is due to removing of scaffolding, extra care for protection of life and limb, and it is a noticeable fact that a bricklayer does not lay as many bricks per hour on a high wall as he will on a wall near the ground. This may be attributable to the fact that he is more careful—naturally—in handling the bricks and mortar and preparing his scaffolding. This fact renders it necessary for the estimator to add 5 per cent. extra for laying bricks in second story, and fully 12½ per cent. for third story, and a corresponding increase for every story above three. This additional increase is over and above extra charges made for extra laboring men as helpers. The estimator must not forget, when figuring out brick work, to take into consideration the number and character of gauged arches over doors and windows, and to make allowance for them.

The foregoing suggestions and rules given will form the basis on which the cost of all brick stables, barns and outhouses that follow are estimated, so that the reader is referred to these figures when brick or stone walls are given in the following examples, and their costs are not figured out. This being made clear, I will now endeavor to show how to estimate on stables, barns and other similar buildings.

Estimating a Stable, a Barn and Outhouses.

Estimating the Cost of a Stable.

Having made estimates for frame and for brick dwellings, it will now be in order to consider the cost of a stable suited to the wants of a gentleman who desires to keep one or two horses and a cow.

Before entering into the matter of cost connected with the erection of a stable, it may not be out of place to intrude a few remarks regarding the sanitary conditions that should be obtained in all buildings where live stock is kept, and more particularly where horses and cows are to be confined for any length of time. All drainage inside a stable should be open gutters made of paving bricks, or of concrete and cement, and should be so arranged that the gutters may be flushed out at will. All floors where horses or cows stand should be slightly inclined toward the gutter, so that all liquid matter will find its way there. A cement floor is the best, but good paving bricks laid in cement are nearly as good as the cement, and are not much more absorbent. On this floor should be laid wooden slats, thick at the back end and thin at the other, so as to make the floor about level where the animal stands. This is important, as it has been proven that a horse rests much better when he stands level in his stall than when he stands on an incline. The cost of putting in a cement floor, including gutter and placing in a stench trap at the end of the gutter, will vary from $2 to $4.50 per yard, superficial. This difference in cost will be owing chiefly to the amount and quality of foundation. If foundation is prepared and ready to lay on concrete and cement, then the cost should not exceed $2.50 per yard. This, of course, does not include cost of stench trap, drain tiles or other necessary supplies. Provision should be made for a good and permanent supply of water, so that the floors of the stable can be washed off and flushed at least once a week. The carriage room should also be well provided with water, and, wherever it can be afforded, it is always best to have the floors below laid with cement, including carriage room, harness room and grain bins or storehouse. This, in a great measure, will prevent rats and other vermin from invading the premises, and is much cleaner and sweeter than wood.

Another very important matter in connection with stables is that they should be well ventilated. The pungent ammoniacal air so common in illy ventilated stables is, in a great measure, responsible for many of the ailments that trouble horses and favorite cows, including moon blindness, cough and epizootic tendencies; besides the rotting of leather and the destruction of the finish on carriages are due almost entirely to the ammonia in stable air. The ammonia can be fixed if, after washing the floor, a light sprinkling of plaster of paris be put on it, this will prevent the ammonia from evaporating; a solution of copperas will have the same effect, but the plaster is preferred because of its innocence in other directions.

Ventilation and Light

Ventilation should be provided in such a way as to avoid drafts. Small openings, which may be easily closed with a slide, may be made in the outer wall near the floor, and similar ones near the ceiling, or in the roof—apart from the towers in the roof—through which the foul air can escape. Pure air is of the utmost importance to the well being of a horse, and no cow can produce clean, healthy milk that is obliged to breathe the ammoniacal air of an illy ventilated stable, and children using such milk are adding to their other infantile troubles.

Another important matter in connection with stables is that they should be erected on a good, dry site, or in some position that can be well drained; for while it is necessary to make use of plenty of water in flushing out and cleaning about a stable, yet the buildings and floors should be so arranged that the water will get away quickly and leave the building perfectly dry before night closes in. If the building is of brick or stone care should be taken that efficient damp courses be laid in the wall below the floor line. If built of wood on a stone or brick foundation, a coating of asphalt or a layer of cement should be laid on the top of the wall before the sills or joists are put in place. The eaves should project from 14 to 20 inches, in order to carry any droppings of water clear of the building, as a horse is more sensitive to damp, when at rest, than a man, and a damp wall will be very likely to give a costly animal some sort of lung trouble that will seriously affect its usefulness.

Another thing to be considered is light in the stables. Whatever windows are employed, they should be well up in the wall, high enough to be over the head of the animal. The windows should be small, and should be filled with thick rolled glass or glass that will not allow glaring sunlight to pass through. The windows should be arranged to open, so that on hot days they may be used for letting in air and for ventilation. A fine wire screen should be placed over the opening to prevent tormenting flies from getting in and annoying the animals.

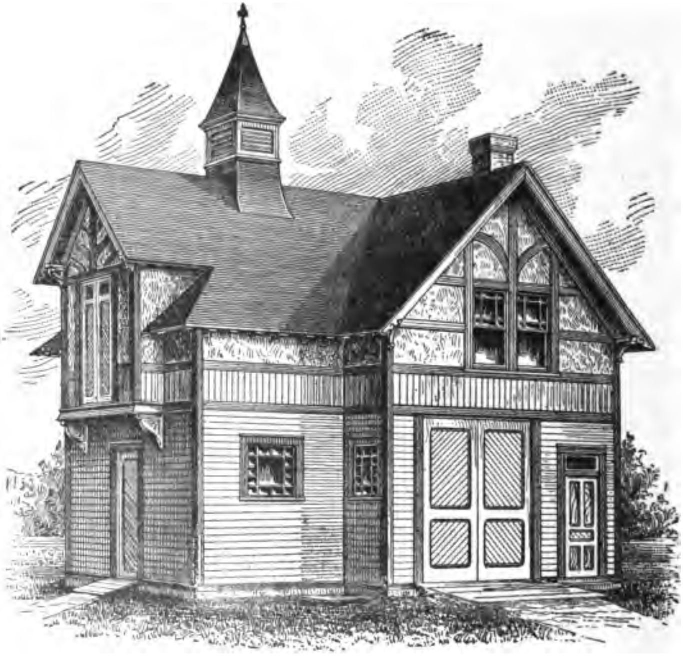

Fig. 1.—View of Stable and Carriage House

An apology, I hope, is not necessary for the insertion of the foregoing suggestions, as this little work may reach the hands of many builders in country places who may not be aware of the importance of ventilation and freedom from dampness, necessary to maintain the good health of horses and cows; and it is for the information of such that these preliminary remarks are introduced.

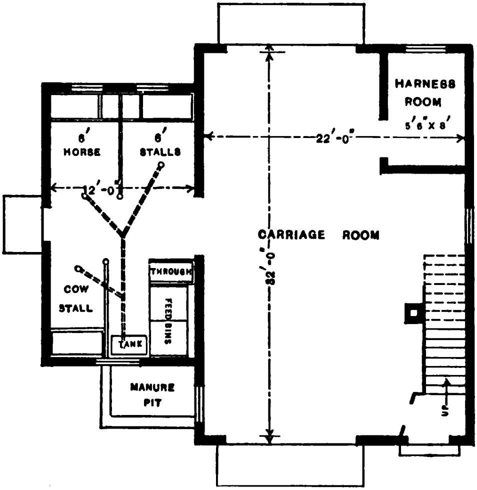

Fig. 2.—Ground Floor of Stable and Carriage House.

Estimating by the Square.

As a model stable, with coach room, harness room, grain bins, manure pit, hay loft and groom's room, I present the annexed illustration (Fig. 1), which exhibits a very neat and convenient structure. This has been erected in at least two States, and in several places in each of the two States. The average cost—in wood and plaster as shown—was $1550. In brick, with Mott's modern fittings, $1900, and in one case in dressed sandstone, with modern fittings, $2200.

From these figures we may get a fairly close estimate of the cost of similarly built stables, if we find the number of squares contained in the lower floor, and divide the known cost by the result.

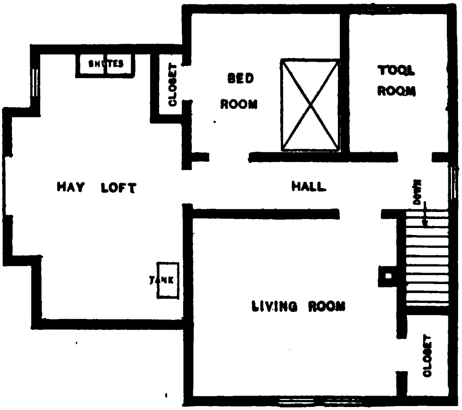

Fig. 3.—Second Floor of Stable and Carriage House.

In the ground plan, shown at Fig. 2, we have in the main building an area of 22 × 32 feet = 704. In the stable annex we have an area of 12 × 24 feet = 288. Then 704 + 288 = 992, or, in round figures, 1000 feet, or ten squares; then to find the cost by this method of the wood and plaster building as represented in the cut by the square, we have \$1550 ÷ 10 squares = \$155 per square.

Now let us take the brick building in which are included Mott's modern fittings, and we have \$1900 ÷ 10 = 190. Here we get the cost per square of floor area, \$190.

Now we have the stone building, in which are all modern improvements in stable fitments, to figure on. The building cost \$2200, therefore we get: \$2200 ÷ 10 = 220. Hence we find the latter building cost \$220 per square of the floor area. For the three styles of buildings, therefore, we have the following: Building of wood and plaster on stone or brick foundation cost per square of 100 feet, super., of floor area, \$155. This includes finishing complete in every particular.

For brick building, including Mott's modern fittings, and under same conditions as previous example, the cost per square will be \$190.

The dressed stone building, including all modern improvements, will cost, according to our method, \$220 per square.

In this method of figuring, it will be noticed, we have constant examples to follow—that is, we have the definite cost given of definite examples; but if a change is made in the character and size of building this method of estimating will fail of giving correct results, though, if used with judgment, it will give figures approximately correct.

As before stated in this work, each item should be figured on, and then, and then only, will there be no excuse for failure in making a correct estimate of cost.

Short Specification of Stable.

It may be well to give a short specification of the illustrated example presented, in order to know something of the building and its attachments figured on.

There are double doors at each end of the carriage room. The hight of ceiling is 10 feet below, and 9 feet to collar beams up stairs. There is a good stone foundation laid in cement under the building. Ventilation is provided as described in the foregoing. The lower floor is cemented throughout, and the stable is drained into a cesspit 20 yards from the building. There is a manure pit built up with vitrified bricks laid in cement; the top of manure pit is coped with appropriate stones. The wooden building is lined inside and out with good, sound sheathing, and this is covered with building paper, the siding, matched stuff, paneling and lath being put over this. Inside lower story is plastered with cement plaster, so that the hose may be turned on it without damage to the walls. The roof is covered with No. 1 shingles, which are stained with Cabot's shingle stain. There are two bins, iron drinking trough, hay chutes, catch basins, racks of metal, metal kicking posts, metal hay manger, harness room with pins, hooks, oil cubboard, and all other necessaries. The second story is finished as a sleeping room, living room, tool room and hay loft, the living part being finished in lath and plaster, well lighted and well finished. The hay loft is lined with matched boards, and is properly ventilated. There is a chimney with one flue, in which provision is made so that a stove may be placed either in the carriage room or in the living room. The whole is painted in three coat work, and the plaster or rough casting on the outside, is also painted three coats, which makes a strong and permanent job of it.

This, then, is an outline of the wooden structure. The brick and the stone buildings are similar in general style, allowance being made for difference in material and the more costly fittings. Both brick and stone buildings are roofed with slate, which, of course, makes some difference in cost; this will be almost double that of a shingle roof, dependent on the cost of freights largely. The louvre acts as a large ventilator, and is connected with the stable proper by a trunk or duct, which is made of matched stuff, and runs down the side of the hay loft, terminating in the ceiling of the stable, where an adjustable shutter must be provided to cut off the draft whenever necessary.

To estimate this building properly, as illustrated, exclusive of the furniture, the rules given for estimating frame buildings in the first department of this work should be followed, and the cost of all the items obtained in detail, for, notwithstanding the fact that the building is known to have cost a given sum under some conditions, it does not follow that it will cost the same sum under other conditions, as the cost of materials and labor is continually changing.

If the building should be constructed of bricks then adopt the rules for estimating the cost as given in the department for estimating brick buildings; making in each case such allowances as may be necessary for any change of style, or for the introduction of more or less cut stone or terra cotta.

The same may be said if the building is to be of stone. The solid contents of the walls should be ascertained; then when the price of stone per cubic foot laid in the wall is known there will be but little difficulty in getting at the true cost, for the wood work in a stone or brick building costs but little more than the finished wood work in a frame building. These facts being known and understood by the estimator, he will be able to arrive at a fairly correct value of the work he is figuring on. These remarks refer only to the building proper, not to the fitments, for these vary so in style and price that only when the kind of fitting to be employed is known can anything like a proper estimate be made.

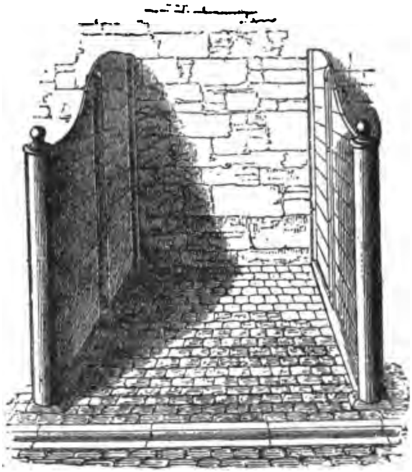

Fig. 4.—An Old Time Stable with Cast Iron Heel Posts.

Stalls and Other Details.

The illustration shown by Fig. 4 is a representation of an old time stall, with bare stone wall at the horse's head, paving brick floor without compensating slats, and boarded sides with cast iron head posts. This kind of a stall was much better than many contemporary ones, but was far from being as good—from any point of view—as those more generally adopted in the stables of the better class of Americans, as evidenced by the illustration, Fig. 5. This illustration gives a good idea of how the interior of a good stable should be fitted up.

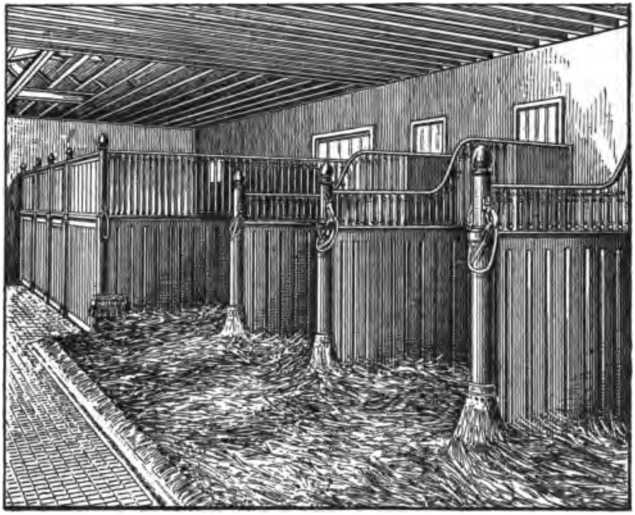

Fig. 5.—Interior View of a Modern Stable.

So far I have dealt only with private stables, but this treatment will be sufficient to enable the intelligent estimator to figure the cost of stables intended for public use, as livery stables, or stables where a large number of horses are kept, as the same rules will apply to a very large extent. A good example of a livery and boarding stable was shown and described in *Carpentry and Building* for the month of March, 1888, well suited for a large town or city, and which may prove useful to those who may require a stable of this kind.

Among the things to be considered in estimating for a stable and its fittings are the following, of each of which the estimator must know the cost before he can close his estimate: Iron grilles, iron light holders, iron stall posts, wrought iron guards, cast iron mangers, automatic feeders, combined mangers and hay racks, corner mangers, pony mangers, wrought iron stall guards, cast iron stall guards, ramp rails for stall partitions, feeding doors in head pieces, box stalls, heel posts, mixing trough, water trough (corner or otherwise), water supply hydrants, open stable gutters, cesspools with bell traps, covered gutters with strainers, covered cesspools with bell traps, angle pieces for stable gutters, sanitary slat flooring, gratings for wood, stone, brick or concrete gutters, manure pit doors in iron or wood, manhole cover, walk box, air bricks, air gratings, ventilators, sidewalk gratings, harness brackets, brush boxes, saddle and bridle brackets, fork, broom and shovel holders, oiling and washing brackets, bit cleaner, girth drier, whip racks, carriage pole brackets, buggy shaft brackets, blanket brackets, cleaning trestles, wheel guards, hitching posts and rings, window guards, weather vanes, stepping stones, drain pipes, catch basins, and all connections with sewerage and water system.

These are not connected with the actual construction of the building, but a number of them are necessary to fully equip an up to date stable.

All other items must be figured as described under the heads of estimating a frame or a brick house, as the case may be. If building is to be of brick, then use rules as given for estimating brick work. If it is to be built of wood, estimate according to rules given for estimating a frame building. Plastering, painting, plumbing and glazing is figured exactly the same as for either wood or brick buildings.

This data places in the hands of the estimator sufficient material to make up an estimate for stable work that should be reliable. Prices for all these items given may be obtained from catalogues and price-lists of manufacturers, a full supply of which should be in the hands of every estimator and builder.

Estimating a Barn.

As no two persons exactly agree as to the design or construction of a house, so we find that no two farmers want exactly the same barn, therefore I have taken as a model on which to estimate, the barn illustrated herewith, because of its being a good type of barn, and one that has been found to answer very well in the Western States and Canada, where timber is the chief material employed in the construction of farm buildings.

The dimensions of the barn illustrated are 32 x 74 feet, with posts 22 feet. It has stable room for 28 cattle and seven horses, and has a capacity for stowing 70 tons of settled hay and 200 bushels of oats and ground feed. The horse stable is 14 x 32 feet, with a hight of 8 feet from floor to joists overhead, and has five single stalls and one double. There are two windows and two outside doors to the stable, also a door opening upon the barn floor. The hay for the horses is run in the chutes from the loft, while the grain may be kept in the feed bin in front of the hospital manger. The bottoms of the hay chutes for the horses are made of narrow strips put 2 inches apart, so that dust and seed may sift through and fall to the floor. The driveway or barn floor proper, as shown in the ground plan, Fig. 1, is 12 feet wide, and its doors are 12 feet high. The interior space is scaffolded above the doors for 12 feet from either end, leaving an opening 8 x 12 feet, for pitching hay, or hoisting it with

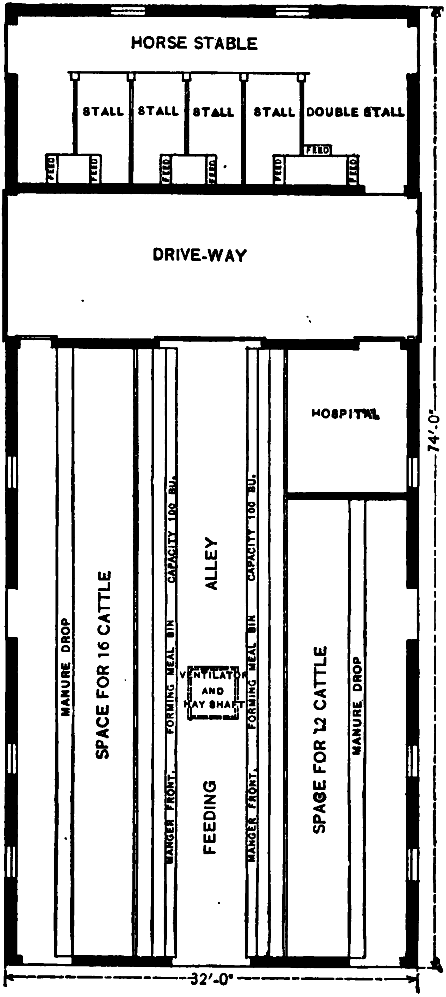

Fig. 1.—Ground Plan of Barn.

a horse fork. The scaffolds are supported by 6 x 8 inch posts, with braced girts, framed so as to form a knee from the side posts out and down to the beam, still leaving all clear above the beam through the middle of the barn. The cattle stable has stanchions for 28 cattle, with a large hospital. The hospital can also be fitted with stanchions to be used temporarily to stable four more cattle if necessary, but, as it is designed for other uses, there is no manure drop in it. The manure drop is made 14 inches wide and 4 inches deep, so that it will hold the droppings for a whole day, and it is so wide that a large scoop shovel may be used in cleaning it. The stanchions are made of selected 2 x 6 inch joists, cut 5 feet 4 inches long. A 10-inch board is put in between the rails at the bottom and nailed outside the rail above, next to the body, so that the sliding post will drop behind it. This board closes the space between the stanchions.

The hay is put down the chute into the alley, and distributed with a fork. It can also be brought in from the barn floor. The meal bins hold all that it is desirable to store in a stable, and are very convenient for feeding. There is no provision made in this specification for feed boxes in the manger, as most farmers prefer to have the manger free from partitions, and clean it every time before feeding meal. The loft is floored with good common matched flooring, so that no dust or grain can fall on the cattle.

All doors to be hung with heavy wrought hinges, with the exception of doors opening to driveway. These are on hangers, and may slide inside or outside as may be decided upon. The stable windows slide upon the girts, and have proper fastenings. The building is boarded up and down with good, sound stock, and is battened with O. G. concave backed battens. The shingles are laid 5 inches to the weather, and held in place by cut shingle nails oxidized.

The ventilating louvres are formed with fixed slats made of 6-inch strips, ½ inch thick, well overlapping to keep out the driving snow or rain.

The building may be set on posts, or it may rest on a stone foundation and have stone piers at intervals of 14 feet under the center timbers. The matter of foundations, however, will not be discussed here, as the cost of the foundation in brick or stone, also the cost of excavation, may be found in the chapters referring to these subjects in the earlier pages of this book.

In all cases of estimating the estimator should have before him some substantial data to figure from, either in scale drawings of the building being estimated on or in specifications of the work, or both. It is better to have both where possible. In the present case I give a side and end view of frame, a ground plan, a side and end view of finished building, and a portion of cross section of main floor, also a bill of materials, all of which should equip an estimator with sufficient data to enable him to make an estimate of cost as correct as it is possible to make one.

Description of Barn Plans.

The ground floor shown at Fig. 1 is explained on its face, and is in itself both a plan and a specification.

At Fig. 2 the whole of the side elevation of frame

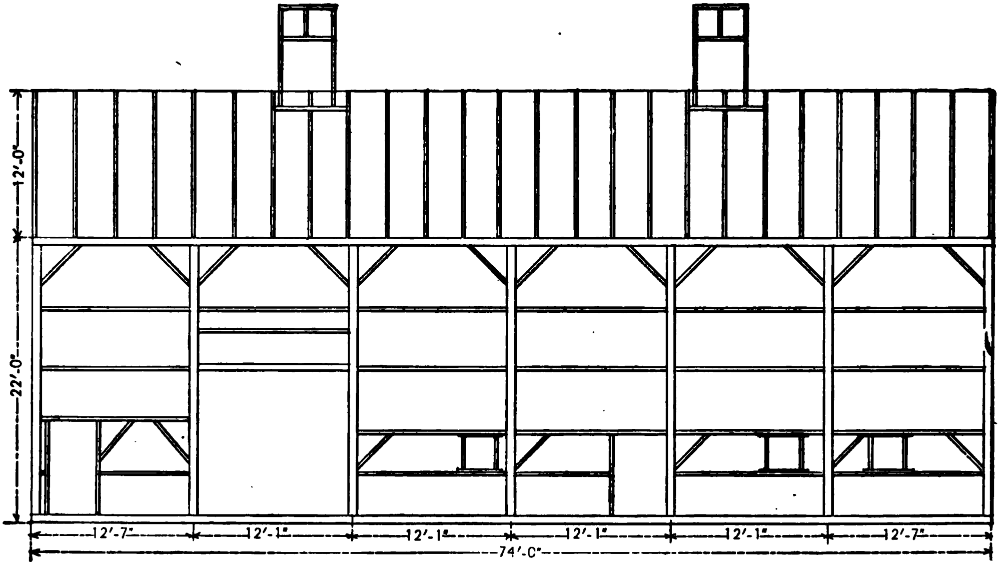

Fig. 2.—Side Elevation of Frame of Barn.

work is exhibited, including sills, posts, braces, girts, rafters, ridge pole and louver frames, with doorways and window openings. The end elevation is shown at Fig. 3, with posts and heavy timber girts, *o, o, o, o,* rafters, and other framings. The elevation shown at Fig. 4 exhibits the manner of framing the "bents" that stand between the end "bents." There will, of course, be five of these intermediate "bents."

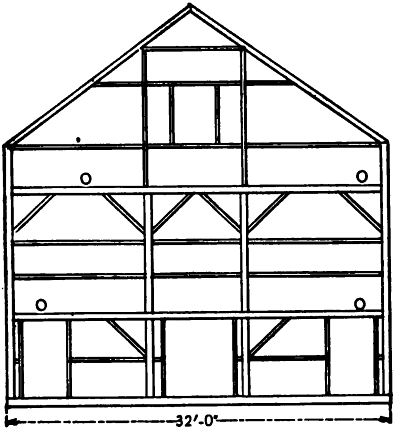

Fig. 3.—End Elevation of Frame.

The section shown at Fig. 5 represents a part of the lower floor, and is lettered for reference as follows:

a—outside sill.
b—manure drop, cut in joists 4 x 18 inches.
c—4 x 6 inch supports for joists.
d—stanchion.
e—mangers.

f—meal bin.
g—cross sill.
h—joists.

At Fig. 6 a side view of the finished building is shown with doors, louvres and windows in place. It will be noticed that the cornice is of the simplest sort, be-

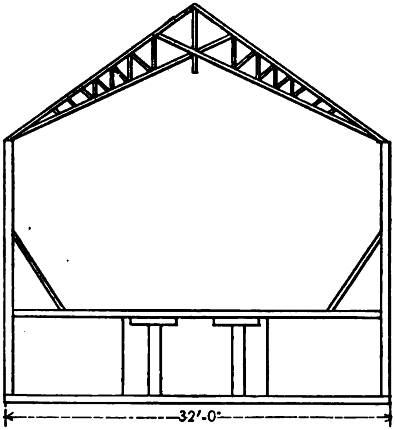

Fig. 4 —Elevation of "Bents' Between Ends.

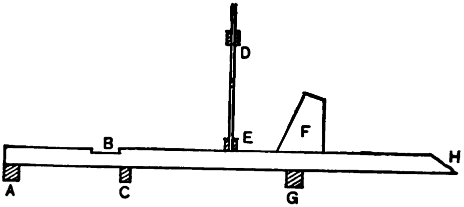

Fig. 5 —Section of Lower Floor.

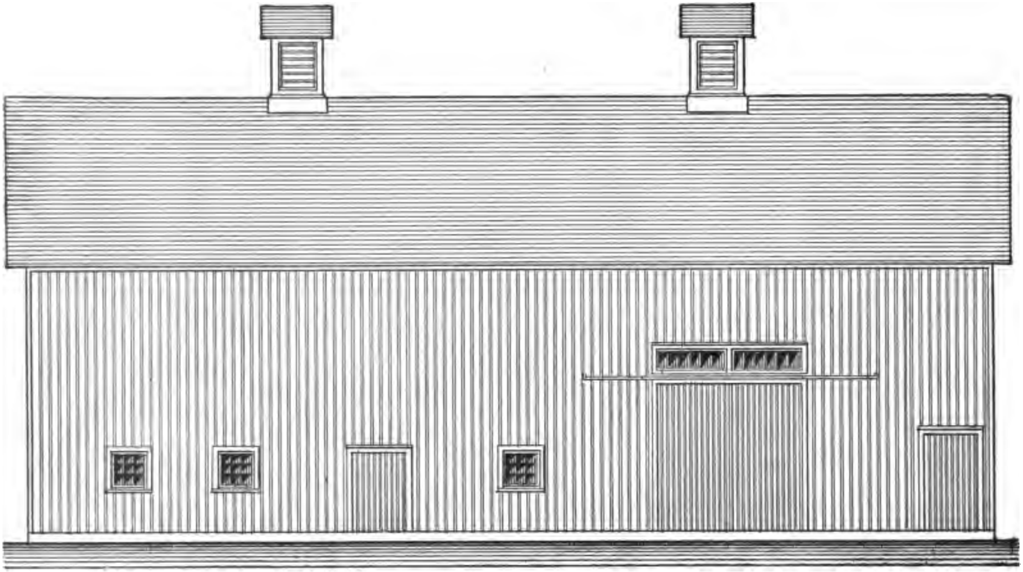

Fig. 6.—Side Elevation of Barn Finished.

ing no more than a planceer on the rake of the roof, a frieze, a plain fascia and a 1½-inch square bed mold.

Fig. 7 shows an elevation of the finished end of the building. The boarding of the gable stands out 1 inch from the face of the frame, and laps over the vertical boarding, as shown, and is pointed on the lower ends, and has holes bored half way through for ornamentation. This makes a water tight joint, and does away with the necessity of butt joints in the boarding.

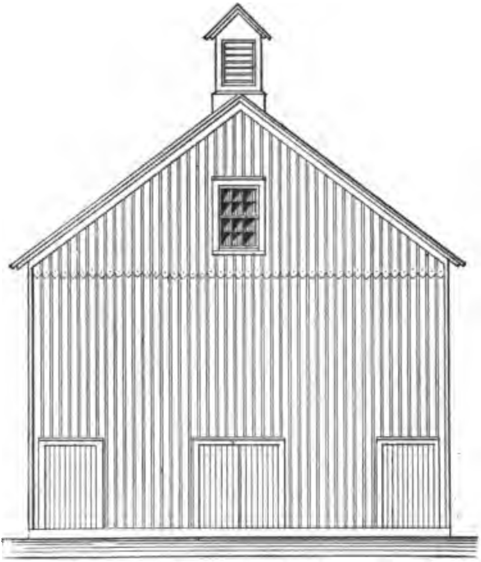

Fig. 7.—End Elevation of Barn Finished.

To these sketches I add herewith a bill of materials that will aid the estimator, not only in this example, but in every similar case:

BILL OF MATERIAL REQUIRED.

LUMBER.

		Feet long.
7 pieces	8 x 8 inches	32
8 “	8 x 8 “	26
6 “	6 x 8 “	26
2 “	8 x 8 “	24
14 “	8 x 8 “	22
100 “	2 x 6 “	22
2 “	6 x 6 “	20
5 “	4 x 6 “	20
2 “	4 x 4 “	20
7 “	2 x 8 “	20
4 “	8 x 8 “	18
2 “	6 x 8 “	18
16 “	4 x 4 “	18
4 “	8 x 8 “	16
9 “	6 x 6 “	16
11 “	4 x 6 “	16
19 “	4 x 4 “	16
14 pieces	2 x 8 inches	16
8 “	2 x 6 “	16
28 “	2 x 4 “	16
35 “	2 x 12 “	16
3 “	6 x 10 “	14
2 “	4 x 6 “	14
10 “	4 x 4 “	14
30 “	2 x 8 “	14
2 “	2 x 6 “	14
2 “	8 x 8 “	12
4 “	6 x 6 “	12
10 “	4 x 6 “	12
30 “	4 x 4 “	12
126 “	2 x 8 “	12
14 “	2 x 6 “	12
18 “	2 x 4 “	12
7 “	2 x 14 “	12
55 “	2 x 10 “	12

28,000 A No. 1 shingles.
2,160 feet of good common boards, 16 feet long.
1,400 feet of good common boards, 14 feet long.
800 feet of good fencing boards, 16 feet long.
2,730 feet fencing flooring, 16 feet long.
175 feet fencing flooring, 14 feet long.
350 feet fencing flooring, 12 feet long.
2,000 feet common stock, 14 feet long.
1,152 feet common stock, 18 feet long.
3,000 feet common stock, 16 feet long.
5,000 lineal feet 2½-inch O. G. battens.
6 windows, 9 x 12 inches, 12-light common glazed.
4 sashes, 9 x 12 inches. 5-light, common glazed.

HARDWARE.

10	iron rods, 9 feet 6 inches by ⅝ inch round.
50	pounds 30-penny spikes.
100	pounds 20-penny spikes.
25	pounds 8-penny clinch nails.
125	pounds 4-penny common wire nails.
400	pounds 10-penny common wire nails.
4	pairs large door hangers, No. 2.
6	pairs small door hangers, No. 1.
8	pairs 10-inch strap hinges.
7	large hoops, hasps and staples.
12	pairs 6-inch T-hinges, with screws.
100	feet iron track, with screws.

There are about 600 yards of painting required, exclusive of the roof. The rules for finding painting quantities may be found in the chapter on painting in another part of the work, so it will be unnecessary to repeat here.

With the data before us, estimating the cost of a barn such as the one shown should be an easy matter, and as this type of a barn is the one that is employed over a very large area of the United States and Canada wherever timber frame barns are built, the cost of such a building should not be difficult to discover when the prices of lumber, hardware, paint and labor are known.

There are several methods adopted by barn builders for estimating the cost of barns, one of which is to figure out every item that goes into the structure, which is the most correct method, but which is laborious and costly—in time.

Another is to cube the contents of the barn, just as one might cube any other building. The rule given for this class of building is from 3½ to 4¼ cents per cubic foot, which, of course. includes all materials, also stone foundation. For labor alone about 1¼ to 1¾ cents per cubic foot will cover the cost. The contents are obtained just the same as the contents are obtained in dwellings or similar buildings, the same rules being applied.

Another method is to find the number of feet of lumber in the whole building, and then levy a fixed sum per 1000 feet for labor, which in this case will be $7 per 1000, with labor at $3 per day of nine hours. This figure is not far out of the way, but, of course, something depends on the kind of workmen employed. This figure covers everything in the wood work, and, as it is an easy matter to find the quantity of material required, and its cost, the total cost of the building is not difficult to get at.

Details in Estimating.

In order to obtain an accurate estimate of any extensive contract, it is necessary that all the details of the various departments of work be considered separately as regards the cost of the production of the material, its manipulation for the particular requirement, the labor expended upon it in preparation, and in the building or fitting up in the structure to be erected. These we shall consider here in the natural order or process which is usually adopted in building operations.

Excavating and Filling.

The natural condition of the site is an important feature primarily to be considered. The nature of the soil, whether it be easy or difficult to excavate; the trees, brush wood or stones which have necessarily to be removed before building operations can be commenced, and the practicability of obtaining an adequate water supply for building purposes, are all essential considerations before proceeding to build.

Excavations are usually measured by taking the length, width and depth of the material displaced, and calculating same and tabulating in cubic yards. The price of same will vary according to the conditions previously mentioned. In ordinary loose soil a man may excavate about 10 cubic yards per day, while in hard or gravelly ground a man may be able only to do 5 cubic yards, or little more, as an average day's work. Again, three men may remove 30 yards of earth a distance of 20 yards in a day. A cubic yard of concrete requires about 3 hours' labor to mix, throw in and level, or if in solid masses and the materials at hand, about 2 hours. The following material, given in cubic feet, will each weigh 1 ton, viz.: sand, 19 cubic feet; clay, 18 cubic feet; earth, 24 cubic feet; chalk, 15½ cubic feet; gravel, 20 cubic feet.

A single load of earth 27 cubic feet, and contains 21 bushels. A double load contains 54 cubic feet. One cubic yard of gravel contains 18 bushels in the pit, and when dug will increase nearly one-third in bulk, but will subside nearly one-fourth in height and decrease one-fifth when formed into embankments. If earth is thoroughly drained an embankment may be made about 1½ slope to 1 in vertical height. Ordinary earth and clay will decrease in embankment after settlement about 1 inch to the foot in height, and sand and gravel about one-third of an inch to the foot.

In digging trenches for foundations, six inches on each side should be allowed for working operations. The prices also should be included for wheeling and laying aside where directed, or for carting away the material as the case may be arranged. When the excavations are very deep, and the soil is loose and liable to fall away, then piles and boarding will have to be employed in protecting the subsidence. In soft ground it costs 5 cents per lineal foot to drive ordinary piles in the usual way, when wages range from 25 to 50 cents per hour. It is difficult to estimate sheet piling without seeing the ground. An average allowance is 25 cents per cubic yard for shoring pieces put in about 4 feet centers in good ground to a depth of about 8 feet; with continuous planking in bad ground, $1.25; for the worst ground, to the depth of about 12 feet, $3.50 should be enough. These amounts should be added to the regular cost of excavation. In the case of corrugated or fluted concrete piles, built up with steel rods and concrete, they run from about 60 cents to $1 per lineal foot in the ground. "Raymond concrete piles cost about $1 to $1.50 per lineal foot. A sheet-iron mould is driven and filled with concrete. The mould is not withdrawn." "Often concrete pile foundations will be found to be cheaper than wooden ones, where the permanent water level is very deep. Concrete pile foundations may also be cheaper than mass concrete ones where the top layer of soil is poor. Sometimes, however, under such circumstances large footings of poor grade concrete may be more economical, or largely spread, reinforced footings."

Concrete.

In estimating concrete work, particular care should be given to the composition of material and its manipulation preparatory to building. Concrete should be composed of pure, clean water, with an aggregate of broken stones, ballast or gravel, and such proportion of sharp sand as will fill up the interstices between the stones or gravel. The aggregates should never be larger than will pass through a ring 1¾ inches diameter. The composition should be in the proportion of not less than one of best Portland cement to six parts of stones and sand combined, while the concrete should be as steadily and evenly set in its place, and tramped down in layers to a depth of not more than 12 inches.

The prices hereafter tabulated include for mixing, wheeling, throwing into position and tamping down. Of course much will depend upon the cost of cement, and the cost of broken stone and sand, or whatever may be the aggregate.

PRICES OF CONCRETE FOR FOUNDATIONS AND PAVING.

For the foundations of walls, etc., circular, straight or in solid blocks, per cubic yard..........................	$6.20
Concrete above foundations, or for underpinning retaining walls, or work of a like character, per cubic yard......	5.50
Blocks of size and shape as may be required, set in Portland cement, moulds included, per cubic yard.........	6.67
Foundations for paving with brick or stone, 4 inches thick, per superficial yard.......................................	.80
Ditto, 6 inches thick, per superficial yard...................	1.00
Ditto, 9 inches thick, per superficial yard.................	1.20
Ditto, 12 inches thick, per superficial yard................	1.40
Floating surface of concrete and finishing it with a fair surface, per superficial yard..........................	.35
Additional if the work be executed between high and low-water marks, including full protection against tides or streams, per cubic yard...............................	1.15

The contents of 100 cubic feet of solid stone, when broken so that the largest piece will pass through a ring 1¾ inches in diameter, will be equal to 189 cubic feet. When to pass through a 2-inch ring will equal 182 cubic feet; when to pass through a 2¼-inch ring will equal 170 cubic feet.

In calculating the quantity of materials required for concrete, the size of the pieces which compose the aggregate must be considered, as it influences the content of the spaces or voids between them, and therefore the amount of cement, sand and lime in the matrix to fill these up. The larger the stones in the aggregate the greater will be the spaces between, resulting in a decrease of bulk in the whole materials after admixture. In some cases the diminution may be as much as a third, but the average of one-fifth may be taken with ordinary materials, while in laying and ramming a further slight compression of one-tenth may occur. The lessening of the bulk must be taken into account when computing the extra amount of materials required, and it is only by actual trial that it may be definitely ascertained by having a water-tight box filled with materials well wetted to obviate further absorption, and measuring the amount of water required to pour in to fill up all the voids. The interstices may be reduced by breaking the stones to as many different sizes as possible, which is of great importance if good concrete is to be made, as the admixture of the cement is intended to combine all the various parts, large and small, of the aggregate, and not to compose a mortar merely to fill up the interstices. The composition of concrete should contain as much broken material and as little mortar as possible; the stone crushing machinery producing more irregular fragments, of various sizes, than stones broken by the hand hammer, though the latter are generally sharper.

The consideration of the shrinkage in bulk of the lime and sand, or cement and sand, as a result of mixing with water, when made into the mortar or matrix, is also of importance.

Twenty-five per cent. is usually allowed for this diminution for lime and sand, while 17 per cent. for cement and sand. The proportion and nature of the ingredients regulate the reduction more or less, which takes place in the shrinkage in bulk of the composition.

Concrete Floors and Roofs.

The composition of concrete for floors, roofs and pavements should have the proportion of one part Portland cement, four parts of broken bricks, slag or other porous aggregate, and be small enough to pass through a ¾-inch ring; but no sand should be utilized in the process. The best material for this purpose is fine ashes from the smith's forge, but it should not exceed in quantity one-third of the whole mass. The process in laying the concrete into position should be gradual and continuous, until the work is completed, and should be tamped concurrently while being laid in place. The concrete laid under boarded floors, tile or brick pavements should be done as previously described, but in the proportion of one part Portland cement to five parts of aggregate, which, after it has been thrown in position, should be nicely levelled off and tamped down with a wooden pounder until it becomes palpy, and the "fat" or cement portion is brought to the surface, when it is usually finished with a fine, smooth face by means of a wooden float.

PRICES FOR CONCRETE FLOORS AND ROOFS.

Concrete floor, as previously described, 4 inches thick, laid complete, per superficial yard	$1.50
Concrete roofs, per superficial yard	1.15
Add for each in thickness above 4 inches	.20
Add if surface is finished with granite siftings, ½ inch thick	.12
Add to floors or roofs, when the underside is exposed and rendered fair with lime putty for limewashing	.15
Concrete bed under wooden floors, ground level, as described, 4 inches thick	1.15
Chases left in floors or roofs for expansion by inserting battens, including use of same, fixing and removing	

and filling up cavity with concrete, and making good surface after removing battens, per lineal foot.......	$0.10
Forming channels in concrete floors or roofs, not exceeding 6 inches girth per lineal foot........................	.13
Extra for forming 4-inch projection to 6-inch flat concrete roof and throating on under side, per lineal foot......	.12
To foregoing figures add for hoisting every 10 feet in height, after the first 10 feet, per superficial yard......	.06

Useful Hints as to Pricing.

The prices which are contained in this work are not to be relied upon for all time. The variations in the prices of material and the wages of workmen are so uncertain that the estimator must obtain some reliable data upon which to base each price that shall conform to current rates. First of all, the plans and specifications must be carefully studied and well understood as regards all that is stated in connection with the contract. The locality of the site should be visited, and the nature of the soil and surroundings should be observed, for upon these important features depend much that will either hinder or facilitate the progress in building operations. The prices of stone, bricks, sand, lime, ballast, delivered on the site, should also receive careful consideration. For these may differ considerably according to the locality. For example, in pricing brick work, the price of bricks in field, the carriage of same to the site, whether by rail or barge, the time in loading and unloading, freight charges and other contingencies must all be considered. Unless all these elements are taken into account, it is impossible to obtain an approximate price. The current prices in the market for the principal items in each trade should be obtained, and for this purpose the trade lists of prices should be always at hand and consulted. The pricing of excavator's work is more difficult than any other connected with building operations, because of the frequent uncertainty in arriving at the nature of the soil, and therefore the labor which would be entailed in digging. If the excavations have to be made to a considerable depth, then a seam of hard rock may be discovered, and this probably would require to be blasted by dynamite. It is advisable then to have a separate item stating the price which would be required if blasting or digging of rock has to be done. The price should be kept separate for excavating loose earth from that of stiff clay or gravel, as the latter materials would cost about twice as much as the former to dig. Also the disposal of the stuff, whether to be wheeled and laid aside at a short distance or to be carted away, should be carefully considered in the cost. The depths of excavations should be stated, whether 6 feet, 12 feet or 18 feet, and the nature of the soil to be manipulated should be regulated by separate prices. Pumping and bailing out water is regulated by the time taken in the operations, and a price per hour may be stated for the performance of same. In the excavation of large trenches and foundation work it would be better to keep this class as a separate item, and described as "excavation and returning, filling and ramming," and the quantity measured as allowing 6 inches from each face of the stone or brick foundation by the full depth. It should be noted that large quantities of some kinds of material, such as sand, ballast or bricks, may be procured at a cheaper rate than smaller supplies, and in some cases a difference of 10 per cent. may be made in the cost. Inquiries should be made at reputable dealers and manufacturers, from whom reliable quotations may be obtained. Again, it may be noted, that the presence of sand on the site may lessen the amount of cartage, as the sand and ballast may be utilized in the building of concrete and brick work. It is better to ascertain previously the depth of the sand below the ground level in pricing the items for excavations. What is above the sand is usually carted away, and allowance should be made for the use of sand on the site. The contractor should allow a certain sum for every cubic yard of sand found on the site and utilize in the building.

The following tables may be of use in giving the "weights of materials" and "some approximate prices" for the guidance of contractors:

WEIGHTS OF MATERIALS.

27 cubic feet equal 1 load and contains 27 striked bushels, or 21 heaped bushels.

54 cubic feet equal 1 double load.

21 cubic feet of river sand (as filled into carts) weigh 1 ton.

22 cubic feet of pit sand (as filled into carts) weigh 1 ton.

22 cubic feet of common ballast weigh 1 ton.

23 cubic feet of coarse gravel weigh 1 ton.

24 cubic feet of clean shingle weigh 1 ton.

28 cubic feet of stiff clay weigh 1 ton.

28 cubic feet of marl weigh 1 ton.

29 cubic feet of chalk (in lump) weigh 1 ton.

33 cubic feet of earth (mould) weigh 1 ton.

A tip cart will hold about ¾ yard cube.

A wheelbarrow contains 1-10 yard cube.

A small earth wagon will hold 1½ cubic yards.

A large earth wagon will hold 3 cubic yards.

1 yard cube of solid earth or gravel contains 27 striked bushels before digging, and 27 heaped bushels when dug.

49 square yards equal 1 rood of surface digging in country.

SOME APPROXIMATE PRICES FOR EXCAVATING, ETC.

Digging in ordinary soils, not more than 6 feet in depth, per cubic yard	$0.20
Ditto, above 6 feet in depth, and not exceeding 10 feet, per cubic yard	.24
Ditto, above 10 feet, and not exceeding 14 feet in depth, per cubic yard	.28
In heavy soils allow extra, per cubic yard	.05
Preparing for foundations, including filling in and ramming, per cubic yard	.28
Reducing the ground to the required level, the average depth not to exceed 18 inches, per superficial yard	.13
Wheeling ground, clay or gravel in barrows, 20 yards run or less	.07
Ditto, or every other 20 yards or part of a run beyond the first 20 yards	.06
Carting and shooting or delivering ditto, not exceeding 1 mile	.85
Ditto, for every additional mile or part of a mile	.28
Calculate wells, not exceeding 8 feet in depth, at per lineal foot, *i. e.*, on the depth. Digging and straining dry, in half a brick, 4 feet 6 inches in diameter	2.30
Ditto, 5 feet 3 inches	2.45

Laying Drain Pipes. Etc.

The size of drain pipes is generally determined by the quantity of sewage to be discharged and the velocity of sewage flow. The usual size for house drains is 4 inches in diameter, unless there be more than ordinary soil or water discharge required. Drain pipes should be laid in perfectly straight lines with an even gradient from point to point, the necessary junctions or branches being within easy access to the inspection chambers or manholes. In ordinary house soil drains the velocity of the flow of sewage should be about 4½ feet per second (270 feet per minute) when flowing full, so that they may be self-cleansing when only a normal quantity of sewage is passing through them. The quantity of waste water and sewage which is discharged from ordinary dwelling houses, for all purposes, varies from 25 to 40 gallons each person per 24 hours. Drain pipes are usually measured per foot run, and the prices to include for digging upon an average of 3 feet deep, filling in and ramming, for ordinary sized pipes. The digging for drain pipes above 12 inches diameter, and where extra depth is required, should be kept separate. The average depth of digging may be taken where differences occur. A bricklayer and laborer will lay and point 100-feet run of 4-inch pipe per day = 10 feet per hour = 1 foot in 1/10 hour.

The following rules may be found useful:

A bricklayer and laborer will lay and joint 1 foot run of 4-inch pipe in 1/10 hour.

A bricklayer and laborer will lay and joint 1 foot run of 6-inch pipe in 3/20 hour.

A bricklayer and laborer will lay and joint 1 foot run of 9-inch pipe in 11/50 hour.

A bricklayer and laborer will lay and joint 1 foot run of 12-inch pipe in 3/10 hour.

For jointing reckon 1 bushel of cement for 36 joints in 4-inch pipes.

For jointing reckon 1 bushel of cement for 24 joints in 6-inch pipes.

One bushel of cement and sand will joint 150-foot run of 4-inch pipes.

The following example may be given of the details in pricing drain pipes and digging, the prices only being assumed, as they may differ in certain localities:

Laying and jointing in cement a 4-inch glazed stoneware drain pipe, including digging trenches in common ground average 3 feet deep to invert, and filling in and ramming.

In the digging of trenches for pipes the width at bottom should be taken at least 1 foot in addition to the diameter of the pipe, to enable the men to operate all around the sockets while jointing; 2 feet wide ought, therefore, to be sufficient for pipes from 4-inch to 12-inch diameter. Each length measures 2 feet.

2
4
6
—— 12-foot cube =

Digging =	12/27 yard cube digging in trenches at 25 cents per cubic yard.....	$0.11
	12/27 yard cube, return, fill in and ram at 12 cents per cubic yard.	.06
Material =	1-foot run of 4-inch glazed stoneware pipe at 7 cents...........	.07
	Cement and sand for jointing.....	.01
	Laying 1 foot of 4-inch pipe = 1/10 hour at 55 cents per hour (bricklayer 40 cents and laborer 15 cents)...............	.05½
		.30½
	Add profit	.02½
	Total cost per foot run........	.33

Bends, junctions, etc., should be priced extra only over cost of pipes, as they have been measured along with the straight piping, so are now merely valued according to the extra cost of the bend, etc., itself over that of a similar length of drain pipe. Allow 2 feet of drain pipe to equal a bend in length; then extra only for a 4-inch bend would be:

Cost of 4-inch bend (= 2 feet of straight pipe)..........	$0.23
Deduct cost of 2 feet of 4-inch pipe at 7 cents............	.14
	$0.09
Add profit	.01
Total cost	$0.10

Brickwork.

MEMORANDA.

SIZE AND WEIGHT OF BRICKS.

Size. Inches	Weight. Pounds.	Weight Per Thousand. Cwts.
8¾ x 4¼ x 2¾	7	63
8¾ x 4¼ x 2¾	7	63
8½ x 4⅛ x 2½	6	56
9 x 4½ x 2¾	8	65
9 x 4½ x 2	6	55
6¼ x 3 x 1½	1½	14

Bricks absorb about one-fifth of their weight in water after 24 hours' immersion.

1½ brick, or 13½ in., is the standard thickness of brickwork.

1 cubic foot of brickwork requires 15 bricks.

1 cubic yard of brickwork requires 405 bricks.

1 reduced rod of brickwork: 16½ feet x 16½ feet =

272 feet superficial of standard thickness of brickwork; 408 feet superficial of 1 brick thick; 16½ feet x 16½ feet x 1⅛ feet = 306-foot cube, or 11 1/3-yard cube; 4,300 stock bricks laid in mortar, gauged four courses to 1 foot high; 5,370 stock bricks laid dry in walls; 4,900 stock bricks laid dry in walls; about 14 tons in weight.

A stack of bricks: 1,000 new bricks closely stacked, which occupy 55 cubic feet; 1,000 old bricks cleaned and loosely stacked, which occupy 72 cubic feet. 500 bricks make 1 cart load. 50 bricks make 1 barrow load. 1 foot superficial of reduced brickwork requires 16 bricks. 1 foot superficial gauged arches requires 10 bricks. 1 foot superficial facing requires 7 bricks. 1 yard superficial of 4½-inch brickwork requires 55 bricks.

1 yard superficial of brick nogging requires: 45 stock bricks laid flat, and ¾ cubic foot of mortar; 30 stock bricks laid on edge, and ½ cubic foot of mortar.

1 yard superficial of paving requires: 36 stock bricks laid flat; 52 stock bricks laid on edge; 36 paving bricks laid flat; 82 paving bricks laid on edge; 70 Dutch clinkers laid herring-bone flat; 136 Dutch clinkers laid herring-bone on edge; 9 tiles, 12 inches by 12 inches, weighing 13 pounds each; 13 tiles, 10 inches by 10 inches, weighing 6 pounds each; 36 tiles, 6 inches by 6 inches, weighing 2½ pounds each; 81 tiles, 4 inches by 4 inches by ¾ inch, weighing 1⅛ pounds each; 144 tiles, 3 inches by 3 inches by ½ inch, weighing ½ pound each.

An acre of brick earth a foot thick will make a million bricks.

1 cubic yard of clay in the solid will make about 450 bricks.

1 cubic foot of brickwork in lime mortar weighs 112 pounds.

1 cubic foot of brickwork in cement weights 115 pounds.

10 hundredweight of fire clay equals 1 cask.

A bricklayer's hod measures 16 inches by 9 inches by 9 inches.

A bricklayer's hod will hold 20 stock, or 16 walling, or 12 facing, bricks; but the number ordinarily carried is 12.

A bricklayer's hod will hold 2/3 cubic foot, or nearly ½ bushel, of mortar, which is sufficient to lay 20 bricks.

A railway truck will carry 3,000 bricks.

A ton of Portland cement equals a yard cube.

MORTAR:

The composition of mortar for building brickwork is of considerable importance. A pure lime requires more water than one with hydraulic properties, as it emits more heat and expands more in slaking; and a newly-burnt lime requires more water than one that has been allowed to become stale. The quantity usually required is between one-third and one-half of the bulk of lime. Therefore extra quantities of materials, equal to this shrinkage, must be added to produce the stated quantity of mortar. The diminution in bulk of dry cement when mixed with water is 10 per cent. of the total; of sand, 20 per cent., and of sand and cement in equal proportions, 19 per cent.

It has been found by experiment that the following amounts of materials are required to make one cubic yard of mortar, in the proportions stated:

Lime mortar, 1 greystone lime to 2 sand	Lime, 11 bushels. Sand, 1 cubic yard. Water, 65 gallons.
Lime mortar, 1 greystone lime to 3 sand	Lime, 9 bushels. Sand, 1 cubic yard. Water, 50 gallons.
Cement mortar, 1 cement to 1 sand	Cement, 12 3/5 bu. Sand, 2/3 cubic yard. Water, 52 gallons.
Cement mortar, 1 cement to 2 sand	Cement, 8 2/5 bu. Sand, 7/9 cubic yard. Water, 40 gallons.
Cement mortar, 1 cement to 3 sand	Cement, 6 2/5 bu. Sand, 8/9 cubic yard. Water, 37 gallons.
Cement mortar, 1 cement to 4 sand	Cement, 5⅛ bushels. Sand, 1 cubic yard. Water, 42 gallons.

Hair mortar is used for bedding and pointing sash and door frames, filleting, etc., and also for plastering. Plain mortar is composed without hair or coal ash, etc., being utilized chiefly for ordinary wall building. A bushel of dry hair weighs about 14 pounds and is classed according to quality as Nos. 1, 2 and 3, the latter being the best. The usual quantity allowed is 1 pound of hair to 3 cubic feet of mortar, making 9 pounds of hair to the yard cube of mortar. The extra cost would be the addition of the hair, and the little further labor required for its thorough admixture with the whole mass.

Foundations.

The breadth and number of courses in brick foundations depend upon the thickness and height of the walls of the superstructure. In ordinary dwelling houses there may be four courses laid brick on bed compactly in the best mortar. The first course 29 inches, the next 25 inches, the next 21 inches, and the top course 17 inches. In calculating the cubic contents of same the average breadth would be these four sizes added together, which makes the total 92 inches, and divided by 4 would give an average breadth of 23 inches. The length of the wall plus 23 inches, plus the thickness, would give the cubic content of brickwork in foundation of wall. The same proportion may be carried out where the foundation courses are more or less in number, as the case may be.

The Superstructure.

The brick walls of the superstructure have been taken up and detailed in a previous portion of this book, but there are several details which may be worthy of consideration that may be introduced into other classes of buildings. Take, for instance, that of scaffolding. There are some buildings which require more scaffolding than others, according to the height of the walls and the character of the construction. Such may require more or less ingenuity in performance, and upon this may depend the number of men employed. There is no definite rule can be laid down, but only the experience gained from the erection of buildings of a similar description may be a guide in determining the time and actual cost entailed. It is a good practice to keep an account of the time and men employed in the performance of a certain class of work, as it may be of value as a reference for determining the price of a similar portion of work which you may be estimating. It is by observing and noting these fine points in detail that facilitate very considerably the process and accuracy in estimating.

Pressed Work.

In estimating this class of work for a fair quantity of material, a good method is to get the price of the common brick in the usual way without deducting the outside course, and then to add the cost of the pressed brick laid down at the building. It may be argued here that to lay brick worth $15 does not require more work than if it were $25, and that therefore the rule is not fair; but we would observe that generally the higher price of the pressed brick the finer the quality of the workmanship must be to suit the architect, who introduces ornament enough to correspond with the value of the material. In estimating the ornamental pressed brick fronts of superior residences, the full thickness of the walls should be allowed, then the price of the pressed brick added, and lastly, about $20 for 1,000 extra on the pressed brick for labor. It is worthy of note to those who estimate on ornamental work that such a rate is not excessive, as it has been proved by results to be reasonable—and sometimes rather risky. The sunk panels, projecting brick, corbels, etc., are generally very costly.

Enameled Brick.

Enameled brick may be estimated in a similar manner as pressed brick. They may be taken at the rate of from $90 to $100 per 1,000 kiln count in the wall. The varieties of pressed bricks are so numerous that it would be difficult to tabulate here the various prices. An ordinary good brick may be had for $15, a better for $25 and a superior for $40 per 1,000. The color may also determine the price of the brick. The standard color is red, and the prices of the various colors run from 30 to 50 per cent. more. The packing on a small order may cost about $7 per thousand. Moulded brick are generally sold along with straight brick unless in exceptional cases. A carload contains 8,000.

Because of the varieties of shrinkage in the clays required to produce the different colors, exact sizes can not be given. The following, however, are approximate:

Standard size, 8⅜ x 2⅜ x 4⅛. Roman size, 11¾ x 1 11/16 x 4.

Impervious white or gray face: Standard, 8⅛ x 2¼ x 4. Roman, 11½ x 1⅝ x 4.

Enameled sizes may be taken about the same. Roman tile is enameled size set on edge. English enameled is 9 x 3. In estimating headers it must be considered that the end is only enameled. Enameled bricks may be had in white, buff, brown, blue and green. In the East a white standard-sized enameled brick costs $75 per 1,000, and a gray porcelain-faced brick $45 per 1,000.

Price List for Pressed Brick.

The following are the prices for ordinary face brick:

STANDARD SIZE.

	Per Thousand
Shade Nos. 1 to 8, red, first grade (any shade)..........	$16.00
Second grade red (any shade).........................	14.00
Shade Nos. 551 to 559, inclusive, buff..................	20.00
Shade No. 550, iron spot, light, medium and dark........	20.00
Shade No. 580, buff spotted (kiln run, fire marked)......	20.00

Shade No. 582 to 589, inclusive, buff spotted	$25.00
Shade No. 570, grey (kiln run, fire marked)	20.00
Shades Nos. 572 to 579, inclusive, grey	25.00
Shade No. 530, bronze	18.00

ROMAN SIZE.

Red	20.00
Red Granite	21.00
Buff	22.00
Iron spot	25.00
Buff, spotted	29.00
Grey	29.00

Brick Cornices.

Standard brick cornices usually run from $1.50 to $3.50 per lineal foot on cars. They are from 2 feet 6 inches to 5 feet high. Allowance to be made extra for labor and mortar from $1 to $2 per lineal foot. Prices are for red; other colors are 50 per cent. higher.

Wall Coping.

Terra cotta wall coping is usually made in 24-inch and 18-inch lengths, and for 9-inch, 13-inch and 17-inch walls. Angles, starters and tee branches are made: straight, 15, 20, 35 cents per foot; corners, angles, returns, ends, starters, etc., cost four times the price of one foot of straight coping. Terra cotta is made of special design and has to be priced accordingly.

Fire Brick.

In estimating the fire brick, take it in the same manner as enameled brick. The latter, however, take a little more time than pressed brick.

Double Face Work.

Those walls which have fine face brick on both sides allowance should be made of 10 per cent. extra after the other allowances have been made.

Quantity Laid.

In ascertaining the quantity of brick that is usually laid in a day under ordinary circumstances will depend upon the aptitude of the bricklayer and the facilities he has in the performance of his work. A bricklayer should be able to lay from 400 to 500 common pressed brick in an 8-hour day. This, however, may vary according to the class of brick he has to handle. The best method is to include the pressed brick along with the common and strike an average.

Chipped Brick.

In the adoption of chipped brick it is principally for effect. It is frequently used on a basement, on arches, bands, etc., and is intended to give variety to the common brick facing. The cost of chipping is about $2 for a reasonable quantity. Sometimes it may be $2.50 or a little more. It may be noted here that all reveals, corners, soffits of arches, etc., have to be returned, and an understanding should be made with the chipper if the work has to be done by the piece.

Price of Common Brick.

The usual cost for ordinary brickwork runs from $11 to $12 per 1,000 wall measure, when bricks cost $7 laid down, but it will depend a good deal upon the size of the building and the character of the work.

Waste of Material.

In all building operations there is more or less waste of materials to be taken into account. It is usually placed at from 2 to 5 per cent. by the authorities. With ordinary good brick 2 is sufficient, and only the poorest class of material should reach 5.

Hollow Walls.

In estimating hollow walls they should be taken same as solid walls of equal thickness, and allow $1.50 per 1,000 extra when both walls are 9-inch; $1 when both are 13.

Backing.

It is usual to deduct the thickness of stone backing from the brickwork and to figure the brick backing by the ordinary rules. Sometimes there has to be done a little fitting against the stone, but there is no exposed work or the plumbing of corners. The brick nogging between partition studs takes about one-half more than straight work.

Hollow Building Tile.

This class of material is usually adopted for the inside of walls to keep out dampness and sometimes for partitions. It is manufactured in various sizes. The prices vary, but the rate of $6.50 on the cars may be taken for as many as will displace 1,000 brick, so that the cost is about the same. An advantage to be noted is that when the large blocks are utilized, the laying goes on faster than with brick. Blocks 4 x 8 x 16 and 8 x 8 x 16 are the common sizes. Partition blocks are made from 1½ inches thick upward.

Cesspools.

The building of cesspools costs more for labor than cisterns, as they are deeper, and both excavation and scaffolding are more expensive. Cisterns are generally made 10 feet deep—cesspools may be 20. Add about 25 per cent. for labor. The cost price of cesspools lined 4½ of brick in cement and plastered with Portland cement may be considered as an approximate as follows: 4 feet inside diameter, $3.25 per foot deep, down to 12 feet; to 20 feet, $3.75; 5 feet diameter, $4 and $4.75 for 12 and 20 feet; 6 feet, $5 and $6. Or, roughly estimated, $1 per foot of internal diameter per foot deep—4 feet 6 inches diameter, $4.50 per foot deep. When deeper than 20 feet allow $1.50—and soil may be such as to make $2 necessary.

Cisterns.

In estimating cisterns they are frequently taken by the barrel at about 90 cents. This price includes digging, 4-inch brick lining on bottom and around arch only, a finish coat of Portland cement and an iron cover. Or the work may be estimated in the usual way; multiply the internal diameter by 3 1/7, the product by the height, and the number of superficial feet by 7½ for wall measure. Add floor, arch and ring. If walls are thicker than half a brick, allowance must be made proportionately. The amount of labor laying brick against earth is about the same as an ordinary wall, as there is no plumbing. The turning of the arch, howexer, takes some extra time. For an 8-foot span, half a brick thick, allow one man 5 hours at most; for 10-foot, 6 to 7 hours. The estimated cost of a 3,000-gallon cistern, 8 x 8 and having 9-inch walls, $100; 3½ cents per gallon or $1.06 per barrel. Walls are 9 inches; 4½-inch walls are reckoned heavy enough.

Mason Work.

The stonework in foundations of a brick house have previously been described, but sometimes stone dressings of various kinds are introduced into the building of the walls to give decorative effect to the style of architecture; and such, along with some other details of mason work, we will here indicate. The two elements in connection with stonework after the material has been delivered from the quarry are the "hewing" and the "building." What is termed "wrought" stone has undergone several processes by the use of the chisel and mallet. The several classes of hewn work in their successive stages may be thus formulated:

Self-faced, rock-faced or quarry-faced.
Scabbling, scappling or quarry-pitched.
Hammer dressing.
Punching.
Pointing or picking.
Boasting or droving.
Tooling.
Stroking or striping.
Sawing or half-plain work.
Plain work.
Dragging or combing.
Rubbing or polishing.
Sunk work and half-sunk work.
Moulded work.
Reticulated work.
Vermiculated work.

Scabbling or scappling is roughly reducing the stones to the desired shape. "Quarry-pitched" means that the protuberances on a rough block of stone are pitched off at the quarry by a pitching tool, which is a chisel with an edge about 2½ inches wide, used along with a mash hammer.

Hammer dressing is of a similar character as scabbling, but not so rough, and is manipulated with a waller's hammer.

Punching is preparing the surface previous to "Pointing," which latter has a pock-marked appearance and is capable of being worked to an unusual degree of fineness, which may be the last finish. Pointing is usually chisel-drafted about one inch around the margins, which are then styled "drafted margins." These borders are here necessary to ensure proper arrises for the exact fitting of the joints of each block, which otherwise would present an undulating surface over its whole face; they are made with a tooth chisel.

Boasting, sometimes termed "Droving," may be described as roughly preparing for a finer finished face. It is usually done with the boaster, or bolster-chisel, at an angle, and varies with the texture of the stone as to the number of blows or lines to the inch, producing a corduroy appearance. Boasted work is "a more regular description of chiselling, in which the marks of the tool run in parallel lines, each successive stroke being made beneath the last, down the whole length of the stone. The same operation is repeated till the marks extend over its whole breadth." The lines are not continuous across the whole width of the stone, but resemble columns. Limestone and grits are the stones which are usually boasted.

Tooling is similar to boasting, except that the strokes make a continuous series of parallel lines, each line extending across the whole of the stone. In fact, tooling is a superior boasting, the tooler or broad tool being a chisel 4 inches wide. Tooling is usually done after the work is boasted, and is more finely finished. Each line or hollow is completed before commencing the following one, and these are at right angles to the bed of the stone.

Stroking, or striped work, differs only from tooling in the direction of the lines, which run diagonally instead of parallel to the edges of the stone.

Sawing, or half-plain work, is the surface produced after sawing.

Plain work is the resulting surface after the inequalities left by the saw, punch or point have been dressed down by chisels and tools, as the former leave their traces in irregular marks over the stone. Half-plain work and plain work are the labors usually left upon the bed and side joints of cut stones in walling.

Dragging or combing is executed by a thin plate of steel with teeth like a saw. It is employed on very soft stones, such as Bath, to produce an extremely even surface, for the sake of appearance, and to prevent the destroying influence of the weather which would otherwise take place on a rough texture.

Rubbing and polishing are produced with an iron implement, used with sand and water.

Sunk work is the labor of forming any surface below that originally done, such as in panels, sloping surfaces of sills, etc. If the original surface was smooth, it is termed "sunk work"; if rough, "half sunk."

Moulded work is as its name indicates, and is, strictly speaking, the term given to profiles with a change of curvature, and should not be applied to cylindrical sections, such as columns, which is circular work.

Reticulated work means imitating net work, and vermiculated work means resembling the movements of a worm. These labors are chiefly placed on quoin stones to give decorative effect and have a margin of about ¾ inch wide enclosing same. The irregularly shaped sinkings between are punched with a pointed tool to give them a rough, pock-marked appearance.

Machinery.

A good deal of the stone dressing is now executed by means of machinery, but the machines are usually employed at the quarries where large quantities of stone are worked, and there are few builders whose business is so extensive as to maintain them. These machines will not only roughly dress stone, but will saw, rub, mould and polish it, and the advantages over manual labor are great, the saving in this alone being at least one-third. There is also a great saving of time in production. The dressing of 30 feet of moderately hard stone by machinery will cost about 50 cents, while the same by hand would amount to a little more than a dollar. Machine-sawing for Portland stone costs 4 cents per superficial foot as against 11 cents by hand, and machine rubbing from 2 cents to 6 cents per superficial foot, according to the nature of the stone.

As regards turning, a stone baluster 1 foot 6 inches high by 6 inches diameter, with twelve mouldings on it, will be finished complete in a treadle lathe in half an hour, after first being roughed out to an octagon form. To work one of these by hand would take a competent mason over three hours.

Waste of Material.

The waste in the manipulation of stone depends largely upon its brittleness, and the irregular shape in which it is raised from the quarry as well as the design to which it has to be formed. The full cubic quantity should be measured, from which the net quantity of material obtained from the length between the finished extreme points is taken. The waste caused in the manipulation of tooled stone will be 10 per cent., and on sawn stone 5 per cent.; which waste should be considered in pricing, although the custom be in measuring net.

Pricing of Stonework, Etc.

The pricing of stonework is regulated by the rules usually adopted in the district where the building is proposed to be erected. The distance from the quarry, the carriage of the material, and its manipulation for the particular requirements, must all be taken into account to obtain an accurate and reliable price. For example, a stone 6 feet long, 2 feet wide and 1 foot thick, laid down at the job in its rough state, would be calculated thus:

$$\begin{array}{r} 6.0 \\ 2.0 \\ \hline 12.0 \\ 1.0 \\ \hline 12.0 \text{ cubic feet.} \end{array}$$

Suppose it cost 25 cents per cubic foot for material and carriage, 5 cents per superficial foot for extra hewing upon the face of stone, and 10 cents per cubic foot for building in mortar; we would have:

cubic feet 12.0 x 25 cts. = $3.00, material and carriage.
super. feet 12.0 x 5 cts. = 0.60, hewing on face.
cubic feet 12.0 x 10 cts. = 1.20, building in mortar.
Add 10% profit, 0.48

$5.28, total cost in building.

NOTE:—These prices are only assumed and not to be taken in costing. The same method may be carried out accurately in any locality, upon any kind of stone required to be manipulated, provided that the particular points in each price are reliable.

The cost of buildings is constantly changing, so it has to be borne in mind that whatever be the prices given in this book the estimator must in every case use his own judgment and true knowledge when making up his tender, and add or deduct whatever percentage may be necessary to suit the variations in prices of labor and materials. During the last decade the cost of buildings of every kind has increased from 30 to 40 per cent.; stone and the more elaborate buildings have increased in a greater proportion than the cheaper kind, probably owing to the higher cost of expert labor and the greater amount of ornate details. An idea of the approximate cost of a proposed building may be derived from a study of the proportional cost of the various trades. For example, in ordinary domestic buildings the brick work and masonry will represent from one-third to one-half of the total cost, unless the building is a frame one, in which case the wood work, including labor and hardware, will represent about three-fifths of the total cost. The following figures show, from actual experience, about the average ratio of costs of the various trades for the erection of brick or stone buildings with slated roofs:

	Percentage of Total Cost.
Excavator and drainage	3.0
Bricklayer and mason	36.0
Slates and roofs	4.5
Carpenter, hardware, etc	34.0
Electric wiring, bells and fitments	4.0
Plasterer, stucco work, etc	6.0
Plumber, heating, etc	8.0
Painter, glazier, paperhanger	4.5
Total	100.0

Other tables may be formulated showing the average ratio of cost for each of the trades in the erection of public buildings, schools, churches, theatres, etc., and which would prove of great assistance to the estimator when figuring up for buildings of a similar character. When the total cost of one building of this kind has been ascertained, with the separate cost of each of the trades named on the same building, the rest is easy, the difference in the size and character of the two buildings being considered. This is estimating by means of comparison. If the brick and stone work of one building costs about 10 cents for every cubic foot of the building, then the woodwork will cost, according to the rule given, about 8 cents and a fraction for a foot cubic of the whole building, and the other trades in proportion as tabulated. This method, however, is rather arbitrary, and although given here is not to be considered as quite correct, but when properly understood the estimator may find it very useful.

Data on Cut Stone Work.

The walls for the building of the Government Printing Office at Washington, D. C., completed in 1903, were built of red bricks trimmed with red sandstone from a quarry near Longmeadow, Mass. The cost of this stone, ready to set, was as follows:

	Per Cubic Foot.
Plain ashlar	$1.80—$2.00
Moulded courses	2.00— 2.40
Sills	2.00— 2.40
Lintels	1.95— 2.15
Columns	3.00

In computing these prices, all moulded and curved or irregular pieces were squared out to the minimum containing rectangular sides. The cost of setting, etc., average for all classes, was as follows:

	Per Cubic Foot.
Handling	$0.133
Setting	.179
Cutting (corrections, etc)	.018
Pointing	.041
Mortar	.012
Miscellaneous materials	.026
Total	$0.409

The rather high cost is due to the care with which the joints were caulked, and to the fact that there was not enough stone to be placed to justify the purchase of a special plant to handle it. Some of the wages paid for

8-hour day on this job were as follows: Laborers, $1.50; stone masons, $4; stone cutters, $4.

Roof Coverings.

In the selection of a roof covering there are to be considered its adaptability and durability for the purpose intended, also its protective qualities against fire, variations in the weather and atmospheric influences. The cost also is of considerable importance, but where it is absolutely essential that it should meet certain requirements the cost must reasonably be conceded. The pitch of the roof in a great measure determines the class of material adopted, as on some roofs the rain or snow may lie for a considerable time and be injurious to the timbers. In warm climates, where the rain may not be frequent, but falls in heavy torrents when it occurs, a roof with a flat pitch is preferable, in order to check the velocity of the rain that runs down the roof. In cold countries where there is much snow during winter, the pitch of roof should be steep, to enable the snow to slide off easily. In Canada and the United States the process of wood shingling is well known, and where there is no contiguous danger of fire, the cost is considerably less than slates, tiles or metal. In large cities or towns, however, the close proximity of buildings, and the various purposes for which they are used, necessitate a roofing material that will be a protection against fire, as well as serving other utilitarian purposes.

Slate.

Slate is a material frequently adopted for large buildings and manufactories in cities, and in many cases the roofs of private houses have been covered with it in various shapes and shades of color, which has added considerably to the decorative effect. The several properties of slate make it a very suitable material for building purposes. Its hardness, yet capability of being split into thin layers and shaped, also the method in which it may be manipulated in covering roofs of various forms and pitches, give it precedence over other kinds of roofing material, if it can be obtained readily and not too expensive. Of course there are quarries which produce different qualities and colors of slate, and the respective purposes for which they are best adapted will regulate the demand for their sale. For protection against fire and ingress of water, slate has long been recognized as a very satisfactory roof covering. Being very hard, and as it absorbs scarcely any perceptible quantity of water, it can be laid on a roof with as low a pitch as 22½ degrees. In the laying of slates on roofs, they should have a certain lap, and that not less than two inches. Thus a part of the slate is exposed in each course, and is termed the gauge, its width diminishing as the lap increases. The method of obtaining the gauge for any kind of slating is by deducting the lap from the length of the slate and then halving the remainder; thus, if Countess slates are laid with a 3-inch lap, the gauge will be $\frac{20 - 3}{2} = 8\frac{1}{2}$ inches. Each course of slates should always "break joint" properly with the one below it. The weight of ordinary slating may be taken at 7 hundredweight per square of 100 superficial feet. There is quite a variety of shapes in slates; thus we have the oblong, the diamond and fish-scale patterns. Again, there are various colors in which they may be obtained, such as blue, sea-green, grey, etc., and these in tints which may vary considerably according to the seam of the quarry from which they are taken.

Tiles.

The custom of roofs being covered with tiles is almost entirely out of vogue and been superseded by shingles, slates or some metallic covering. Yet, in many of the countries in Europe, especially in small towns or villages, the red clay tiling for roofs is very common. This method is more frequently adopted for cottages or smaller buildings, and in certain situations the red tiling has a very picturesque appearance. Tiles are made from clay in a similar manner as bricks, but as the clay is of a tougher character, considerably more care is to be exercised in their manufacture. The clay is excavated and weathered, and then ground in a pug mill, by which means it acquires considerable consistency. Thereafter it is formed into the desired shape, by being pressed into an oak mould, platted with iron. The clay is prevented from adhering to the moulds by dusting the latter with sand or fine coal dust. The tiles are thereafter exposed to the open air, where they are dried, and then they are baked in a kiln similarly constructed to a brick kiln, but inclosed in a conical building termed a "dome." The time occupied in burning depends upon the quality of the clay and the color to which it is intended that the tiles should be burnt. This is a general description which applies to all roofing tiles, but of course the moulding processes are regulated according to the class of tile which may be required. There are the two classes of tiles, viz.: pan tiles and plain tiles. The former have a double curved surface, on the one side convex and the other concave, which is executed on the plastic clay by the hand. By the formation of a small hollow in the mould a projecting nib is made by which the pan tiles are hung on the laths of the roofs. Pan tiles are usually made 14½ x 10½ inches, and generally laid to a gauge of 10 or 11 inches. These tiles are more commonly adopted for inferior kinds of buildings, as it is not easy to keep a roof watertight with them for any considerable time, the rain having a tendency to drift underneath them. They are only partially overlapped, but not in a sufficient manner to make a thorough watertight joint, and are consequently often pointed with mortar, which has an ugly appearance and soon cracks and gives way through the influences of the weather. The usual weight of pan tiles is about 10 hundredweight per square. Plain tiles are oblong in shape, having a slightly curved surface, and are made either moulded with nibs for hanging on the laths or may be formed with two holes for nails or pegs. The size usually manufactured is 10½ x 6½ inches. Plain tiles of this size should be laid to a 2½ gauge and hung by nibs or pegs driven through the holes in their surface. Frequently builders have been known to bed the beading joints in mortar, but it is questionable if this be a good method. This certainly makes the roof tighter at first, but frequently the roof falls because of the laths decaying, and so permitting the tiles to slip and the presence of the mortar accelerates the decay. Again, when mortar is used the tiles will be inclined to depend upon it for keeping the tiles in position and will not give due attention to the hanging and pegging of each tile. By not giving the latter the necessary care, the roof which is subjected to changes of temperature and wind pressures may suffer slight movements which will tend to loosen the mortar joints and cause the mortar to give way and fall into the cave gutter. In some rural districts the custom has been adopted of laying hay on the top of the laths, which is a good plan if properly executed, as it also adds considerably to the warmth of the house in winter. It is advisable that tiled roofs should have a pitch of not less than 45 degrees, although 50 degrees of a pitch is to be preferred.

Felt.

For covering the roofs of out-buildings, felt has been in use for many years. But frequently it is adopted in addition to the shingles or slates of houses, being placed underneath as a preventive against the ingress of rain through the sarking, as well as keeping the interior of the building in a warm condition. It is necessary that the sarking boards be thoroughly close, and then the felt put on, having the edges of the sheets overlapping. The roofs of out-buildings that are covered with felt are usually of a very flat pitch, just sufficient slope to throw the water off in one direction, and instead of having eave gutters, there are small fillets of wood nailed to the boarding, sloping upward in two directions and meeting at the bottom, where there is an outlet formed for egress of the rain. These fillets also are usually covered over with the felt. For light roofs this method of covering is very satisfactory, provided it is carefully laid, and may keep watertight for a considerable time.

Copper.

For flat roofs metallic coverings are frequently adopted. Copper has been sometimes utilized for this purpose, but being expensive, its adoption is very limited. It slowly oxidizes when exposed to the atmosphere, but the oxide does not get right through into the metal, as is the case with iron, but is rather a protective coat.

Zinc.

For a metallic roof covering, zinc is one of the lightest, its specific gravity being slightly less than that of copper. Its expansion, however, is greater than that of any other metal, and therefore great care should be exercised in laying it. When zinc is adopted it should not be less than No. 16 gauge, which weighs about 24 ounces to the superficial foot and is about 1/24 of an inch thick. Zinc is somewhat like copper, in that it oxidizes on the surface only, but in smoky atmosphere it will not last at all, as the sulphuric acid operates very detrimentally to its destruction. The fact that the outer surface of zinc only oxidizes when exposed to ordinary atmospheric influences, suggested the idea that iron, if coated thinly with zinc, would prevent it from corroding, and so we have now what is known as galvanized iron. The process of galvanizing consists in first precipitating tin upon sheets of iron by means of weak galvanic action, and then laying the plates in a bath of liquid zinc. Iron, when manipulated by this process, under ordinary favorable conditions, may last for a considerable time; but when nails are inserted in any of the sheets, then at these apertures rain may find its way, even into the iron itself, and corrosion take place, which is manifest by the thin flakes which peel of the surface. What was previously described as the action of sulphuric acid upon zinc, thus demonstrates the futility of the adoption of galvanized iron in smoky localities.

Lead.

Of all the materials adopted for roof coverings, especially for large and heavy structures, milled lead is one of the most durable. The thickness of lead varies from 0.075 to 0.236 inch, and the weight of these, respectively, being 4 pounds and 14 pounds per superficial foot. The standard of qualities which are chiefly adopted for roofing purposes are the 5, 6 and 7-pound lead, the latter being the lightest that should be used for flat roofs or valley gutters. It is important in the laying of lead upon flat roofs that they be close boarded, and allowance should be made for the expansion and contraction of the metal, therefore the joints formed by the two adjacent edges of the sheet should never be soldered together. For the prevention of water percolating through the joints there are fillets of wood, 2½ inches x 2 inches, pounded on top, termed rolls, and nailed to the boards. One sheet of lead is dressed close up to, and half way over, the roll, and then the next sheet is brought up to the opposite side of the roll, and lapped completely over the roll and the upturned part of the first sheet. When the lead is hammered down closely to the battens with wooden mallets, then no nails are required and are better to be omitted. In cases where nails are required, such as around skylights, etc., copper nails should always be adopted.

Prices of Roofing Material.

The prices for the various materials adopted for roofing purposes are regulated by the locality where the building is being erected and the distance which may intervene between the points of exportation of the material and the site. The most satisfactory way of arriving at the prices is by applying to the nearest wholesale dealers who will supply contractors or others with lists of prices of the various materials laid down at the nearest railway station or port. When these have been supplied, then the superficial contents may be measured and the several prices attached and calculated, which, of course, would be regulated by the wholesale dealers' prices and the extra percentage charged for labor entailed and profit necessary to make the job pay. There may be very little difference in the prices supplied by the dealers in material, but it requires considerable care and accuracy in taking off the quantities and ascertaining the amount necessary for the several portions of the work, for if too much be ordered there may be waste or loss incurred, and if too little, the shipment of a small quantity will cost more, and thereby add to the loss side of the account.

Carpenter and Joiner Work.

In estimating for this department of work, it is more reliable and satisfactory to have a proper system in measuring the several parts and detailing them upon sheets of paper or in a book for future reference. There are the two distinct classes of work, viz., the "rough timbers" and the "finishings," or "trimmings," as they are commonly termed. The "rough timbers" embrace all joisting, beams, rafters, standards, posts, frames, roof couples, lintels over openings, etc., which is the carpenter's work. The "finishings" include the windows and doors, with their trimmings, bases, skirtings, surbases, wainscoting, mantelpieces, and other fixtures. In the first place, take off the number of sleeper joists and the lengths and scantling of same. Then the floor joists in a similar manner. Those joists which are "scarfed" or "notched" should have this particularly noted, as extra labor is entailed and has to be charged. Beams also should be specified, whether sawn or dressed, and whether made up in two or more thicknesses. The labor fitting iron work on beams should also be noted.

The wall plates and runners on partitions or walls should be measured and scantling specified. The standards, runners and dwangs of framed partitions should be measured per lineal foot. The rafters, purlins, hip rafters and valley gutters should be accurately measured and specified according to their respective class. It is a good method to mark on the plan in plain figures the dimensions and measurements of the building which you propose to estimate.

Begin then with the sills, taking their lineal measurement, and from their size estimate the number of feet, board measure. The labor entailed upon the sills may be described as of three kinds: "First, framing without gains for joists or mortises, for studding as in common building when the studding is spiked to the sills, and the joists rest on their top. Second, with mortises for studding, gains for joists, or studding without mortises. Third, with both mortises and gains." Those sills (6 x 8) which are framed and placed in the building by the first, second and third methods, will usually cost for labor about 4, 6 and 9 cents per lineal foot. Sills (12 x 16) will cost about double these prices specified.

Any intermediate sizes may be approximated from the previously-named figures. Thereafter consider the pricing of the joists, beams, runners, standards, rafters, etc., which have been measured and noted down. Joists are usually placed 16 inches from center to center, and when so placed the number of joists on any given floor may be ascertained by taking three-fourths of the length of the building and giving an extra joist where they are placed on top of the sill, and taking one less where the end sills are utilized instead of joist. The joists of first floor are usually 2 inches x 8 inches to 2 inches by 14 inches. Those joists for second floor are usually 2 inches by 8 inches to 2 inches x 12 inches. The ceiling joists, where usually no floor rests on, are 2 inches x 6 inches to 2 inches x 8 inches.

It is computed that two men may frame and put in position in a frame building not more than 3 stories high 600 lineal feet of joists in size from 2-inch x 6-inch to 2-inch x 14-inch material in a day of 8 hours. While in brick structures not exceeding three stories in height, including anchoring and leveling up, 400 feet. For buildings 4 stories high 350, and for buildings 5 stories high 275 lineal feet.

Scaffolding.

A very important feature is that of scaffolding required for a building. This will depend upon the character of the structure to be erected, and which shall regulate the amount of material necessary and the labor entailed in its construction. In some cases this is a very costly item, especially in the erection of churches or public buildings with open roofs, large domes or high towers. In the erection of towers or open roofs, not only are there required numerous bracing pieces, needles, etc., but great caution and ingenuity are necessary to secure the strength and safety of the structure. A wide experience in this class of work is absolutely essential for carrying out efficiently such operations, and it is this experience alone that will enable a contractor to figure accurately the amount of material required and the time employed in its erection. The material usually adopted for heavy and high scaffolding is of the very best and well seasoned timber, as the purposes for which it is employed are very hazardous to life, and if not thoroughly strong and erected with the greatest practical skill, the results may prove very disastrous.

The handling and erection of the timbers require, not only strength, but also great dexterity in placing them in those positions which will be both convenient and secure. All these features and several others, such as the distances the timbers have to be carried, etc., are to be taken into consideration in forming an estimate of the amount of scaffolding required for the particular building about to be erected. The character and style of the building, and the height of its erection above ground, will regulate the number of planks, trestles, bracing pieces, needles, etc., required for the scaffolding, and the amount of men employed in this department of work. It is no easy matter in some instances to form an adequate idea of all that would be required for an extensive and high structure, unless great care and intelligence be exercised in formulating the details, and pricing and calculating the amount of material and time employed in the erection of scaffolding. The description given of this important department of work is sometimes so vague that it requires the contractor to devote much of his time to ascertain the particulars of what will actually be required to carry out this branch of the work in the erection of the building. The material used in scaffolding may be carefully handled and taken down after the work of erection has been completed and utilized again for a similar purpose. In such cases the temporary use of the material and the labor entailed in the erection, taking down and removal of the scaffolding, are the chief features upon which are based the calculations in forming an estimate. In extensive jobs where a clerk of works or building superintendent is constantly employed, there is usually a small frame house erected for his convenience, in which there is a table and desk fitted up, the former having a drawer for the plans and specification, and the latter for writing upon and containing any documents or time sheets connected with the work. These particulars, however, should be minutely detailed and described in the specification, leaving nothing whatever to the imagination of the contractor, or whoever it be that has the duty of framing and calculating the amount of the estimate. Jobbings throughout the building should never be included along with "scaffolding," but be kept as a separate item.

Arrangements of Items Previous to Pricing.

After the sills, sleeper and floor joists, the roof timbers, beams and runners have been measured from the plans and minutely tabulated on sheets or in a book, then the finishings of the building may be noted down. We begin by taking off the number and size of the windows, with their trimmings separately detailed. Then each class of the doors are particularized, defining the mouldings in which they are finished, and the trimmings connected therewith. The ironmongery of the windows and doors may be noted at the same time. Thereafter dado linings or wainscoting may be measured and the quantity calculated. Skirtings, bases and timber mantelpieces may be measured and described. In order not to make any omission or mistake in enumeration, it is a good method to begin with the grounds or basement floor and take the one class of items in each floor until the last is taken on the upper or attic floor. By this means we have each class of items separate, and their description will regulate the prices to be adhibited according to the kind of material and labor to be expended in their finish. This process facilitates to a remarkable degree the pricing and gives greater accuracy. There are several elements of importance to be noted when considering the pricing of each item, and these particulars should never be omitted. There is first, the kind of timber to be adopted, and whether first or second class, then the dimensions in which it is to be made, and the labor entailed in its manipulation and fitting it up in position complete. For example, a timber beam 6 inches x 10 inches and 6 feet long, dressed on four sides of best red pine. The contents in cubic feet has to be calculated thus: 6 feet x 6 inches x 10 inches = 2½ cubic feet. Labor, dressing same on four sides, 6 feet x 2 feet 8 inches = 16 super. feet. Labor, inserting same in position, and percentage of profit on item. These prices added will give the cost accurately. The percentage of profit may be kept out of reckoning until the final summing up if the same rate of percentage be applicable to each item. By this example it may be seen how simple yet accurate is the process of arriving at a proper and reliable estimate if the time be taken in noting down, calculating and extending the priced items at reasonable and current rates where no loss would be entailed. The same method may be carried through with the other items tabulated. There is a tendency to give a lump sum, and that only "guesswork" for several items together; but this is a great mistake, as it does not facilitate the process of arriving at an "accurate" account of the work, and may be the means of causing a serious loss in the long run if many of the items are valued in this slip-shod manner. The difficulty lies in each contractor having to extract the quantities from the plans by his own method, instead of having an uniform, well arranged and accurate "bill of quantities" whereby to be guided in pricing the detailed items. Whenever the latter system comes into practice, then, and not till then, will competing contractors be enabled to estimate upon a satisfactory and reliable basis. And it is because of the ambiguity of details in specification, and the laxity and carelessness, or gross neglect, on the part of the contractors, who are figuring upon the job, that there is frequently so much disparity in the amounts of the tenders receiving after being calculated and estimated, that they have been sometimes all rejected and the work not proceeded with until more accurate and satisfactory offers have been received.

Rules for Guidance in Pricing.

Although there be no tabulated "schedule of quantities" supplied as a basis to form a proper estimate, yet it is better that the contractor, for his own sake and security, measure as minutely as possible the several items of his department of work. When he has done this accurately, it is advisable that he apply to the wholesale lumber dealers for their quotations upon the different classes of material required for the building and to be carried and laid down on the site. He can also ascertain the price lists for window sashes and doors and base his orders for same according to the size and class of material required. This may be done so far in some instances, but there may arise certain questions as regards the material which cannot be settled by price lists, and can only be solved by diligent search and reliable information in the matter. When this has been done and the price of material been satisfactorily obtained, then the labor expended upon its preparation and fixing it in position should be added to the amount. Frequently the class and quality of material, whether difficult or easy in manipulation and preparation, will regulate the pricing of the items. Again, the time which some tradesmen take to perform a certain piece of work in comparison with others would affect the profit or loss in the contractor's account. The rise and fall in the market prices of material are also important contingencies to be considered in framing an estimate. For this reason the contractor should be ever on the alert to the trend of events in this direction, so that he may come as near as possible to what will likely be the standard prices during the currency of his contract. There is a mistaken idea, and one very dangerous to adopt, that in pricing it is better to keep on the low side than on the higher standard of rates. A medium course is more commendable and safer from a financial standpoint to the contractor. Were this rule adopted by each contractor competing for a job there would be less disparity in the amounts contained in the tenders and more satisfaction obtained by all concerned. It is a good thing to bear in mind all these points previous to, and during, the process of measuring and calculating the quantities and prices of the several detailed items of the contract. It is of importance also not to omit the smaller items, which all count in the final summing, and which, if neglected to be taken into account, may result in a serious loss at settlement. The item termed "jobbing" is frequently very ambiguous to the mind of the contractor, and it is wise for him to come to a definite and reliable conclusion as to all that it means. Whatever may be the interpretation of the word and all that it includes, to the mind of the contractor, it is usually understood by the architect and owner, to be everything essential to complete the work of the contractor in a thorough and satisfactory manner to their minds. The contractor, therefore, should not only study the details as given in the plans and specifications, but take into account also those minor items which have not been particularized and draw the attention of the architect to them, so that they may be noted in writing and prevent any misundersanding or disputes at settlement when the contract has been completed and formally taken out of contractor's hands. The vagueness in the construction and phraseology of so many specifications is the frequent cause of litigation between contractors and the architects and owners.

The prices for material and labor vary in different localities. The shipment and carriage of the material to the site where the building is to be erected should be considered as a separate sum. Again, there may be considerable difficulty in getting men employed to work on the job, unless much higher wages be given than usual, because of the distance they have to travel to and from the building when out in the country. These are important features which regulate the prices to be charged in compiling the several items of the contract. The nature of the material to be used and the time required in its preparation for the purpose intended also enter largely into the consideration of the price. The processes through which the material has to pass before it is the finished piece of workmanship, and fitted into its position in the building may be varied and of an intricate and complicated character, involving a great expenditure of time. Thus, timber beams may be built up in sections and bolted together with iron bolts and nuts, or they may be mortised and tenoned at the joints. According to the amount of time expended in these and other operations will the prices of the work be regulated and the accurate cost of the total labor in the preparation of the material obtained.

Again, there are several different kinds of "splices," "scarves," and "joints" employed in the construction of the parts of carpenter and joiner work. Now, there are some more difficult to perform than others, and it becomes a consideration of what workman should be set to this particular work, and if he be able to do it within a reasonable time and in a satisfactory manner. How this is to be done must be the decision of the contractor before he can affix a price that would include all the necessary expenditure of time involved. The arrangement as to the apportioning the work to the several workmen for the expedition and thoroughness in which it will be performed is another feature that will operate to a considerable degree in arriving at the prices necessary to be included. Without the power of organization and concentration to carry out a certain amount of work within a given time, the contractor figuring upon any large contract is unable to compete with others who have these, in a great measure, gained by experience. There is the power of handling a large body of men and setting each to his respective class of work according to his ability that will enable the whole work to be completed within a certain time. The contractor or foreman who knows his men well, and the capabilities of each, and by his tact can get the desirable amount of work performed by them is usually able to form an idea of the time involved in any certain class of labor. For this reason it is a good thing to keep some men in constant employment with the same firm, even although they may not be so busy as at other times. For good men are sometimes rarely to be had at the time most needed, and it is a loss to the contractor who has to put up with an inferior workman who wastes his time or spoils his material. Thus, we observe that the pricing of the various items in carpenter and joiner work can be brought to a very fine point in order to obtain an accurate and reliable price. It is by experience and analysis of the several elements which compose each item to be so treated that this faculty can be acquired. A close and assiduous study of the market prices for material is an absolutely necessary source of knowledge to obtain. The shipment and carriage of the same to the site come next; then the amount of labor entailed in its preparation and building or fitting up, and the percentage of profit desired. These and several other contingent elements have been indicated, and if the contractor gives the adequate care and attention to these particulars he should be able to form a proper idea of the price to be affixed to each item and an accurate and reliable estimate of the full amount necessary for the completion of the contract.

Glazier's Work.

Although this department of work takes a minor place in the consideration of building construction, yet when viewed from the aspects of beauty and utility in our modern architecture, it supplies certain requirements of no little importance. The class of building will necessarily call for a certain treatment to be adopted in the choice of glass and the glazier's work. Buildings of an ecclesiastical character, according to the style of architecture adopted, require the kind and shape of glass in harmony with their own particular class. Again, buildings of domestic architecture may have those varieties of glass consistent with the period and style of the class chosen. In the ordinary dwelling house there is great variety in the quality of glass which we find adopted. If there be many windows in the house, then it is preferable to have that kind of glass which is most suitable for the special requirements of the apartment. For windows in the principal rooms, such as dining, drawing and sitting rooms, it is better to have polished plate glass, as it admits unbroken rays of light and has a more elegant appearance than the other inferior kinds, although more costly.

There are several different classes and qualities of glass manufactured, viz., plate glass (polished and rough), sheet glass, crown glass, ornamental and colored glass, and lattice work or diamond-shaped. The important question in estimating for glazier work is, how the different kinds are to be measured. All manner of glass shall be measured at its extreme size, and fractional parts of inches shall be reckoned as full inches; those panes which are of irregular shapes shall be measured as the same size of the squares required to cut them from and be kept separately. In measuring plate glass, give the size of each pane as 1, 2, 3, 4, 5, 6, 7 or 8, superficial feet, above 8 up to 20 feet to step 2 feet at a time, and above 20 feet in content to step 5 feet at a time. What is understood as "polished plate glass" is, that it is polished on both sides, but if it be polished on the one side and rough on the other, then it must be distinctly stated so and classed separately. In all case the thickness of glass should be stated, and whether it be of English, American or other manufacture. The labor entailed in grinding or polishing the edges of plate glass should be charged by the lineal foot, stating the thickness of glass. Sheet glass should be measured at its extreme size and described as best, second or third quality.

It must be borne in mind that all fractional parts of inches be charged as full inches. Those plates which are irregular shaped should be charged as the squares required to cut them from and classed by themselves. When measuring sheet glass which weighs 15, 21 or 26 ounces per superficial foot, the contents of each pane should be stated as not above 11 feet, the understanding being that no pane shall exceed 50 inches in length, and in width 36 inches; when above 11 to 21 feet, the contents should be stated in steps of 2 feet, while the length may vary in contents from 55 to 80 inches and the width from 38 to 48 inches. Where the sheet glass weighs 32, 36 or 42 ounces per superficial foot, the contents of each pane may be noted as containing not above 8 feet, the understanding being that there shall be no pane exceeding in length 45 inches or in width 34 inches; above 8 feet up to 14 feet, the steps upward to be noted every 2 feet, while the length varies, according to contents, from 50 to 60 inches, and the width from 36 to 40 inches; above 14 to 19, the contents to be noted in steps of 1 foot, while the length may vary, according to the contents, from 60 to 85 inches, and the width from 40 to 47 inches; all sizes which are above this to be mentioned in detail for each pane, as generally few sizes above 19 superficial feet are made.

The measurement of crown glass should be taken the extreme size and tabulated as best, second, third, fourth, or coarse quality; when wanted more than the ordinary thickness made, it should be distinctly specified, and the fractions of inches, as usual, to be charged as full inches. When estimating or measuring crown glass, the contents of each pane should be stated as under 2 superficial feet, and every foot upward thereafter to 5 feet; above 5 feet superficial contents the size of each pane should be stated separately.

In estimating all kinds of ornamental glass (whether it be plate, sheet or crown) the measurement of the glass should be as already described, and the class of ornamentation to be minutely detailed. When colored glass is only 6 inches or under 6 inches broad, it should be measured by the lineal foot; but when above 6 inches in breadth it should be measured by the superficial foot, and if ornamented, besides being colored, the ornamentation should be accurately detailed.

Where there is lattice-work and glass they should be measured together and not by the pane; but in compartments or lights each of these being measured at the extreme size, while the fractions of inches are to be charged as full inches. The glass in tracery heads or the like should be classed separately, and the price should include for any moulds that may be required.

In the pricing of lattice-work it should include for iron stiffening rods and copper wire fixing; also, for pointing and painting, the diameter of the rods and their distance apart from each other to be particularly stated.

The glass of those windows which have small panes, each containing under 2 superficial feet of sheet or crown glass, and separated only by astragals, should be measured within the frames, but over the astragals, the fractional parts at astragals not to be counted, but the fractions at frames to be counted as full inches.

When glass is cut to the angle or circle, it should be measured by superficial foot, and described as such and classed separately. Bent glass also should be detailed separately, and price should include moulds that may be required. The prices of glass should include priming, puttying, pins, catches and work glazing.

Various Methods of Estimating.

There are four or five different methods of estimating, but the greater number of them are not considered reliable by the careful and generally successful contractor, who will run no risk of loss by using any method appearing to have an uncertain element in it. As a rule, he sticks to the old, reliable, but laborious system of working out his estimate, by figuring on every item that enters into the work for which he intends to tender.

One of the so-called rapid methods of estimating is to take out rough quantities and price the items as this work proceeds. All the quantities and workmanship may be gathered from the drawings and specifications in a broad and comprehensive manner, the work being condensed into a few specific items, such as floors, windows, doors, etc., and priced accordingly; this method is less used than some others, yet it is about as reliable as any of them. This system requires a little more time to work it out than some of the other ready ones; but an expert will do it as quickly as cubing, and it will be about as correct. In estimating by this method, it will be well to add a liberal allowance for unforeseen contingencies.

When rough quantities are being taken out for an approximate estimate, it is desirable that the various descriptions of materials and workmanship should be grouped together so as to form as few separate items as possible; also, in all cases where it can be done, the items should be priced as per square of 100 feet superficial, for the sake of uniformity and convenience.

The walls should be classed according to their materials and thickness, at the same time stating whether external or internal. Each item should include all necessary digging, footings, doors, windows, and finishings of wall surfaces, such as plastering, facings to external walls, etc., so that the item, and consequently the price, shall be inclusive of everything that appertains to the various enclosures or divisions of the building. For this purpose the superficial area of the walls should be obtained by taking the extreme length of each wall by the height from the bottom of the footings to the top of the eaves, in cases where the thickness of the wall is the same throughout. Should the wall vary in thickness, either in its length or height, each portion should be measured separately. No deductions must be made for door, window or other openings. Bay windows, chimneys and other additions of a like nature should be numbered and priced according to their materials and workmanship.

The floors may be dealt with in a manner similar to that described for the walls. The ground and upper floors must be kept separate, and classed according to the materials and finishings required. The item for wood floors on the ground floor to include sleepers, dwarf walls, joists, boarding, hearths, etc., together with a layer of concrete on brick rubbish over the whole area, and all necessary digging for same. Similarly, concrete or other floors will include all materials, labor, and finished surfaces that may be required. The upper floors to be treated in a similar manner. The item to include all joists, boarding, hearths, ceilings, cornices, and whitening or coloring the same. The roof coverings to be measured on the slope, the item being inclusive of roof trusses, rafters, boarding, shingling, slating or other covering, leadwork, eave-gutters, down pipes, etc. Ceiling joists, ceilings and whitening or coloring to ceilings will also be included in the same items here required.

Drains, gas and water mains, electric wiring, and items of a similar nature, should be taken at per foot or per yard run, according to sizes, including all necessary digging, laying, filling, and removal of surplus materials. manholes, disconnecting pits, etc., to be numbered and priced according to size and average depth.

Staircases to be taken at per step, or per foot in height, classed according to their widths and the nature of the materials and finishings. Gas and water fittings to be priced at per light or per tap, including all service-pieces from mains, digging, etc.

Fitments or furnishings generally, such as cupboards, baths, sink, w. cs., ranges, grates, mantels, etc., are numbered and priced according to the class of fitments, material and finishings required.

The third method of estimating is by the square of 100 feet, which, under some circumstances, is quite convenient for obtaining approximate cost. Its use is principally confined to one-story buildings, such as sheds, stores, schools, churches, chapels, stables, railway stations, bungalows and similar buildings. It may, however, be used for buildings two or more stories in height; but a considerable amount of discrimination and care must be exercised in order that the final result may be relied upon.

The superficial area is obtained by taking the dimensions from out to out of walls at the ground level, so as to include any projection of the plinth or other offset which frequently occurs at the base of a building. The result is commonly called the *plinth area* of the building. Where the materials, workmanship, or height of building or floor varies, each description or height must be kept distinct, in order that they may be separately priced.

In case of one-story buildings, the price per square includes foundations, walls, floor, roof, and all finishings. Occasionally data are at hand by which buildings comprising two or more stories, such as warehouses, etc., may be priced in the same way, the price per square of "plinth area," including foundations, walls, ground and upper floors, roof, etc., all complete.

Sometimes two-story buildings have both floors priced all the same rate, as it is found that the average cost of the ground floor, including the foundations, is about the same as that of the first floor, which includes the roof covering.

It is also useful to remember that the floor area of a certain description of buildings affords some indication of the amount of accommodation provided. For class-rooms in schools, the floor area accommodates from seven to ten scholars per square, being an allowance of 14 to 10 superficial feet per child.

Ordinary churches accommodate from nine to twelve persons per square, corresponding to a total floor area of 11 to 8 feet superficial per sitting, respectively. In mission churches, etc., the floor space frequently averages about 7 feet per sitting, or at the rate of fourteen persons per square. These figures include the floor area, which is necessarily absorbed by aisles, pulpit, choir, vestry, sanctuary, etc.

The actual amount of floor space required per person for seating accommodation in churches is from 4½ feet to 5½ feet, superficial.

Pews, or sittings, in churches are usually spaced from 34 to 36 inches apart (measuring from back to back of seats), whilst the average length of seat required per person is from 20 to 22 inches.

A fourth method of estimating is by unit of accommodation, and in practice it is found that for certain descriptions of buildings or works, constructed under normal conditions, the cost of such buildings or works varies (within certain limits) in a direct ratio to some known unit of accommodation or requirements.

For such buildings as hospitals, schools, churches, factories, etc., the cost can be approximately given, if the number of patients, children, etc., required to be accommodated is known. On occasions when time will not admit of even a sketch of the proposal being made, this method affords oftentimes the only ready means of ascertaining the approximate cost. Similarly, for certain minor accessories where the cost of materials and construction varies but slightly for units of the same class, as in a range of latrines, etc., the approximate cost can be easily determined in the same way.

The most correct method of estimating is by taking out accurate quantities of materials and items of all kinds and pricing them as the figures are obtained, and then adding the cost of labor to each item. This method, because of its entailing so much labor, should be adopted only when it is intended to carry out the work and when a tender is sent in or submitted for work about to be gone on with. It is very laborious, and necessitates great skill and a thorough knowledge of building construction, and particularly of the work to be tendered for, so that the subject is somewhat difficult for young hands to deal with. In this method a full set of drawings of the work and copious specifications are necessary, so that the estimator can take the dimensions from one and quality of material and character of work from the other. The cost of the various descriptions of material and workmanship is then priced in accordance with the current rates obtained in the locality where the work is to be carried out. In fact, it is the only method a young contractor should use when commencing business. After years of experience and observation as a builder and contractor, cubing, or one or other of the quick methods, *may* be made use of under certain conditions, where the contractor knows what he is about. My advice, however, is to stick to the old and reliable method of estimating by items. It takes time, but the time and labor are well invested.

It is but just to say that these rules and methods can be found in many works, but it has been thought expedient to reproduce them here, so that the student may have them at hand when making use of this work for study or for practical estimating. The rules and problems are selected chiefly from educational works, and the tables have been prepared by competent authorities, and have been examined and corrected, where necssary, and made suitable to the work in hand.

In previous pages I have shown at length how a detailed estimate of the cost of any ordinary building may be ascertained; and while the process is somewhat lengthy and tiresome, it is decidedly the better method for the younger estimator to follow, as it has many advantages over all the others, beside being the best of practice for the figurer and will make him familiar with all details pertaining to building and construction.

A few remarks on the much-lauded cubing system may not be out of place at this point, as it is the best known method after the "detailed" and the most usually adopted for hurried estimates, because of its general convenience.

In this case the dimensions are best taken by measuring the length and breadth from out to out of walls and the height from half foundation to half way up the roof. The cubic contents then obtained are multiplied by the price per foot of some building of similar style whose cost per cubic foot is known.

The cubing method is open to many objections, for the lumping together of voids and solids is not by any means a scientific process, for the same class of buildings may be divided into many rooms with many shapes and a great number of doors and windows, while the one being estimated upon may have much larger rooms and fewer of them, which would, of course, make quite a difference in the total cost. This method requires a large experience and a nicety in pricing which the estimator cannot always possess. The description and quality of materials and workmanship, too, are seldom the same; neither are the conditions of contract, and these variations are frequently overlooked when a certain rate per cubic foot is assumed.

Sometimes it may be necessary to give an approximate cost of a building in a hurry, and the following table has been prepared to satisfy just such occasions:

Cost of each room in tenements..............	from	$350	to	$450
Cost of each room in cottages................	“	290	“	360
Cost of each room in residences..............	“	320	“	420
Cost of each room in villas, etc.............	“	450	“	700
Cost per patient in asylums..................	“	1,400	“	1,650
Cost for each soldier in barracks............	“	750	“	900
Cost of churches, plain, per sitting............	“	45	“	60
Cost of churches, ornamental, per sitting.....	“	68	“	134
Cost of first-class stables, per cow............	“	175	“	195
Cost of first-class stables, per horse...........	“	200	“	225
Cost of second-class stables, per cow.........	“	120	“	135
Cost of second-class stables, per horse........	“	150	“	165
Cost of third-class stables, per cow...........	“	75	“	95
Cost of hospitals, complete, including all offices, buildings, etc., per bed..................	“	1,500	“	2,200
Cost of cottage hospitals, per bed............	“	1,000	“	1,200
Cost of general hospitals, per bed............	“	500	“	750
Cost of isolated hospitals, including all necessary offices, buildings and other conveniences, per bed...........................	“	1,750	“	2,250
Cost of buildings put up in a hurry for temporary occupation, per head..............	“	90	“	100
Cost of latrines for barracks, per seat........	“	75	“	100
Cost of city and town lodging houses, per bed.	“	275	“	375

Cost of music halls for cities and towns, per head	from	$75	to	$125
Cost of music halls for small towns, per head.	“	35	“	75
Cost of schools, complete, large cities, per scholar	“	60	“	100
Cost of schools in small towns and villages, per scholar	“	42	“	62
Cost of schools in country places, per scholar.	“	35	“	45
Schools, infant schools, per scholar	“	25	“	35
Cost of theaters, complete, large cities, per seat	“	80	“	110
Cost of theaters, small cities and towns, per seat	“	48	“	82

These examples are given for brick buildings of good style. If the buildings are of stone, from 10 to 20 per cent. must be added, according to the quality of the stone and amount of ornamentation. There are theatres in New York, Chicago, San Francisco and other large cities that cost per seat 50 per cent. more than I have figured in the list; but these are exceptions to the rule.

Estimating by Units of Accommodation.

This method of estimating does very well for certain descriptions of buildings, such as churches, schools, prisons, hospitals, stables, and buildings of a similar kind; but apart from these it has no value, and its value in the cases mentioned is not by any means a fixed factor. The system is based on the known cost of buildings which give so much space to each scholar, patient, sitting, horse, or prisoner. Thus, if we know how much a stable costs that was built to accommodate twenty horses, it is a simple matter to estimate how much it cost per one horse space; for if the building complete cost $4,000, that would give the cost per horse at $200.00 So, also, with schools. If we know of a school for 100 children that cost $10,-

000, we know that each sitting cost $100.00; therefore, it is reasonable to suppose that other schools, everything being equal, will cost $100.00 per sitting. It must not be forgotten, however, that conditions are not always the same, and while a "jumped" figure of this sort may be, and is approximate, it is not always correct; for no two buildings, even though they are side by side and built concurrently, can possibly be built at the same actual cost. I have seen the attempt made on several occasions, and the variations amounted to from 3 to 7½ per cent.—quite a large amount if taken from the 10 per cent. profits of the work.

On occasions where time will not admit of even a sketch of the proposal being made, this method affords oftentimes the only ready means of ascertaining the approximate cost. Similarly, for certain minor accessories, when the cost of materials and construction varies but slightly for units of the same class, as in a range of latrines, etc., the approximate cost can be easily determined in this manner.

Really, this method is estimating by comparison.

Some Notes.

A few of the things necessary to know in connection with estimating on excavation are the capacities of the tools and appliances required on the work, such as I give below:

An ordinary one-horse cart, 6 feet long by 3½ feet wide and 2½ feet deep, will hold 45 cubic feet, or 1 2/3 cubic yards.
A regular builder's cart will hold 1 cubic yard.
A tip-wagon will hold, when heaped, 3 cubic yards.
A large wheelbarrow will hold 1/10 cubic yard.
A small wheelbarrow will hold 1/12 cubic yard.

A basket holds a bushel, or 1/21 cubic yard.
50 barrow loads make a good wagon load.
A stone wagon will carry from 2½ to 6 tons.
A double load of earth equals about 56 cubic feet.
A single load equals some 27 or 28 cubic feet.
A single, generally, is about 1 cubic yard.
A single load, generally, is about 1 ton of stone, brick, etc.
500 bricks make a single load.
400 pressed bricks make a single load.
1,000 plain roofing tiles make a single load.
1,000 slates, counters, make a single load.
1,000 feet dressed lumber make a single load.
50 cubic feet of timber make a single load.
1 cubic yard of mixed mortar make a single load.
16 bushels of lime make a single load.

Earth in excavations weighs about as follows:

1 cubic yard of common earth, 2,400 pounds.
1 cubic yard of top-soil earth, 2,000 pounds.
1 cubic yard of clay earth, 2,700 pounds.
1 cubic yard dry sand earth, 2,700 pounds.
1 cubic yard wet sand earth, 3,000 pounds.
1 cubic yard of sandy loam earth, 2,400 pounds.
1 cubic yard of mud earth, 2,500 pounds.
1 cubic yard of gravel earth, 3,000 pounds.
1 cubic foot of cement concrete, 6 broken stones, 1 sand, 1 cement, weighs 130 pounds.
1 cubic foot of concrete, 6 broken bricks, 1 sand and 1 cement, weighs 120 pounds.
1 cubic foot of concrete, 6 broken ballast, 1 sand and 1 cement, weighs 140 pounds.

Increase in the bulk of earth, clay, etc., when excavated and thrown into a loose heap:

	Before Digging	When Dug.
Earth and clay.............	1	1¼
Sand and gravel...........	1	1½
Broken stones..............	1	1½
Free stone..................	1	1¼
Rock generally.............	1	1½

These figures are common property and have been published in trade journals and building books many times; but in one of this kind they seem to be a necessity, as they are useful and reliable.

FORM OF TENDER.

TENDER.

I hereby agree to build, complete and furnish all specified materials for the proposed house—*or other building*—to be erected for John Doe, on Lot 20, Cypress street, Middletown, N. Y., in accordance with plans and specifications prepared for that purpose by Fred. T. Hodgson, architect; and subject to the usual conditions, for the sum of nine thousand two hundred and fifty dollars ($9250.00).

RICHARD ROE.

MIDDLETOWN, N. Y., August 10, 1901.

NOTE.—If materials are furnished by owner, or tender only for one of the trades, make changes to suit conditions.

FORM OF CONTRACT.

CONTRACT.

These articles of agreement made and entered into this........ day of............, A. D. 1901, between...................... of the city of Middletown and State of New York, of the first part, and..........................of the city of Middletown, State of New York, of the second part.

WITNESSETH, That the said party of the first part, for and in consideration of the payment hereinafter to be made to.......... ....by the said party of the second part, doth hereby *contract and agree to build, finish and complete*, in a skillful and workmanlike manner, all work under this contract, as follows:

....

....

....

All to be done to the satisfaction of Fred. T. Hodgson, architect and superintendent, and finished...........................1901.

....

Said work to be erected in the city of Middletown, State of New York, as aforesaid, so as to fully carry out the designs of said work, as set forth in the accompanying specifications and plans and drawings therein especially referred to; said specifications, plans and drawings being declared part and parcel of this contract. The said first party also hereby agrees to complete the work as follows:

....

....

....

And the said party of the second part, for and in consideration of the party of the first part furnishing all the materials and faithfully executing the aforesaid work, so as to carry out the design for the same, as set forth in the specifications, and according to the intent thereof, and to the satisfaction of Fred. T. Hodgson, architect, and at the times mentioned herein, doth hereby agree to pay to the said party of the first part the sum of nine thousand two hundred and fifty dollars ($9250.00), as follows: ....

....

....

....

In witness whereof the parties hereunto have set their hands on the day and year above written.

RICHARD ROE. [L]
JOHN DOE. [L]

Witness: JACK PLANE.

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